PATENT
Docket no. 1173-1061PUS3

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: Peter L. COLLINS et al. Conf. No.: 5376

Appl. No.: 10/789, 400 Art Unit: 1632

Filed: Februrary 27, 2004 Examiner: Shin-Lin Chen

For: RECOMBINANT HUMAN METAPNEUMOVIRUS AND ITS USE

DECLARATION UNDER 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

I, Dr. Peter Collins, hereby declare as follows:

1. I am a U.S. citizen, residing at 2921 Woodstock Avenue, Silver Spring, MD 20910.

2. I am presently employed as Senior Investigator at the National Institutes of Allergy and Infectious Diseases of the National Institutes of Health. A copy of my Curriculum Vitae is attached.

3. I am a co-inventor of the subject matter of the above-identified U.S. Patent application. I am familiar with the specification and pending claims, and with the prosecution history of the application.

4. The Examiner has rejected claims 1-4, 6-8, 15, 16, 18, 25 55 and 56 of the application as being obvious in view of Bermingham et al., *Proc. Natl. Acad. Sci. USA,* 96:11259-11264 (1999)

in view of Van den Hoogen et al., *Nature Medicine* 7:719-714 (2001) and Van den Hoogen et al., *Virology* 295:119-132 (2002).

5. The Examiner asserts that Bermingham teaches the NdeI and K5 mutations, and a few others, that together are made to ablate expression of the M2 ORF2 of HRSV. The Examiner notes that Bermingham use a "minigenome" comprising a Chloramphenicol Amino-Transferase ("CAT") gene under control of RSV transcription and termination signals to direct synthesis of CAT in the presence of RSV N, P and L proteins, thus as an indirect measure of RSV viral growth in culture. Bermingham et al. are also described as showing that virus lacking M2-2 protein grew less efficiently in vitro and that the authors conclude that the M2-2 protein functions to switch the virus state between one of transcription of viral genes to replication of the viral genome.

6. The Van den Hoogen (2001) paper is cited as teaching the sequence of HMPV, an element necessary to provide enablement of the present invention and plainly lacking from the disclosure of Bermingham, which is directed to a virus distinct from HMPV.

7. The Van den Hoogen (2002) paper is cited as teaching that HMPV infection is a significant clinical problem, causes clinical symptoms similar to RSV, and like RSV is a member of the Pneumovirinae subfamily.

8. The Examiner concludes that one of ordinary skill in the art would have found it obvious, that is, a mere application of ordinary technical skill, to construct a recombinant HMPV or an expression vector having a partial or complete HMPV genome or antigenome comprising one or more attenuating modifications (as in claim 1 as filed), with a reasonable expectation of success in obtaining the present invention.

9. To the contrary, achieving the present invention required considerable inventive activity over what had been disclosed by Bermingham and Van den Hoogen.

10. Whereas RSV viruses can be recovered by reverse genetics methods and propagated in a wide number of cells of human, hamster, bovine, and simian origin, HMPV appears to replicate well only in two lines, namely African green monkey Vero cells and Rhesus monkey LLC-MK2 cells. This is unexpected and unexplained. Furthermore, HMPV replicates much more slowly than RSV, with an infectious cycle of 72-96 h or more compared to 24-48h for RSV. Final yields are reduced by approximately 10-fold or more, which further complicates studies. It is substantially less cytopathic, making it difficult to monitor growth. HMPV also depends on added trypsin in the medium for growth. Because trypsin is unstable due to self-cleavage and metabolism by the cell monolayer, one must first determine optimal conditions for growth and trypsin addition and re-addition, which vary with cell type. Because of the poor growth of HMPV, we had to develop the rescue system using a construct expressing green fluorescent protein as a living tag to monitor recovery and infection. We also could not use the traditional method of supplying T7 RNA polymerase with a vaccinia virus recombinant. This is because, given the long replication cycle and poor growth of HMPV, the rapidly growing vaccinia virus would kill the cells and preclude recovery. This is true even for attenuated strains such as the vaccinia MVA strain, since they remain very cytopathic compared to HMPV. For that reason, it became necessary to develop an amplification method in which we used an available baby hamster kidney cell line that constitutively produces T7 RNA polymerase for initial infection, and co-culture with susceptible Vero or LLC-MK2 cells. This allowed recovery of recombinant virus despite poor growth in the BHK cells. All of this required considerable experimentation and technical skill to finally achieve reliable recovery of recombinant HMPV from cDNA clones.

11. At the time the invention was made, there were reasons to be skeptical of RSV as an exact model for HMPV. The two viruses have been classified in different taxonomic genera, which is an unambiguous scientific determination that the viruses are substantially different. RSV has two additional genes (NS1 and NS2) compared to HMPV. There are some proteins that seem to be similar between the two viruses. However, the most similar ones (such as the

nucleocapsid protein N, phosphoprotein P, matrix protein M, and polymerase protein L) are present in a very wide array of viruses spanning four or more virus families involving widely different viral species. Thus, the presence of proteins bearing the same name is not necessarily indicative of close structural similarity or predictability of function. In addition to lacking the NS1 and NS2 proteins of RSV, HMPV has a different gene order for four of its eight genes compared to RSV. Since gene order is the single most conserved feature of the nonsegmented negative strand RNA viruses, this is indicative of significant difference between RSV and HMPV. Also while the disease caused by HMPV has some similarities to that of RSV, the virus infects later in infancy than RSV and elicits a very different host cytokine response.

12. Between HMPV and RSV, there is 36% amino acid identity between the two putative M2-1 proteins. This is a fairly low value, but the two proteins also share a cysteine-histidine motif that, for RSV, was shown to be important for M2-1 function. In contrast, there is only 12% identity for the two M2-2 proteins and an absence of any shared motif or conserved segment. A value of 12% is insignificant in the absence of conserved motifs, and hence there is no relatedness at all in M2-2 between HMPV and RSV. The M2-1 protein is essential for RSV replication: its deletion is lethal. However, even though M2-1 of HMPV has significant sequence relatedness with that of RSV, and shares a cysteine-histidine motif, we found that it was not essential for replication of HMPV. Specifically, HMPV from which the M2-1 coding sequence had been deleted replicated nearly as efficiently as wild type in cell culture. In addition, HMPV lacking both M2-1 and M2-2 replicated nearly as efficiently as wild type HMPV in cell culture. Thus, deletion of the M2-1 protein, which seems to be related between RSV and HMPV and in particular has a conserved cysteine-histidine motif known to be important for function in RSV, yielded results that were completely different than expectations. Since M2-2 had no sequence relatedness between the two viruses, and further given the contrarian results with M2-1, it would not be reasonable to be able to expect that results related to M2-2 of RSV could be extrapolated to HMPV. That is to say, contrary to the assertion of the Examiner that one who read Bermingham et al. would expect that elimination of the M2-2 protein expression from HMPV

would provide an attenuated HMPV, this is **not** so, and this is evidence of unobviousness of the present invention.

In other words, the contrarian results obtained with the M2-1 protein illustrate that RSV and HMPV are significantly different – consistent with their classification into different genera – and demonstrate that one cannot rely on a low level of sequence relatedness or other vague similarities to make predictions between viruses from different taxonomic groups.

13. Other aspects of HMPV biology have proven to be different from RSV. For example, with RSV, the attachment G protein is a major neutralization and protective antigen, and is essential for replication in mice. In contrast, for HMPV, the G attachment protein is not a significant attachment or neutralization antigen and is not essential for replication in mice or in non-human primates. Furthermore, whereas RSV G has sequence relatedness to the CX3C chemokine called fractalkine, and mimics its chemotactic activity in vitro, there is no such sequence relatedness between HMPV G and any chemokine. In addition, the RSV G protein is expressed abundantly as a secreted form in addition to the membrane-anchored form. This secreted form functions as an antibody decoy to help the virus evade neutralizing antibodies and also shifts the polarization of T helper cells. Whereas the secreted form of G plays a central role in RSV biology, there is no known secreted from of HMPV G. This is another example involving a protein that seems somewhat similar between RSV and HMPV, but which turns out to have substantial functional differences and for which the effect of deletion is very different. In particular, the finding that G is a neutralization antigen for one virus (RSV) but not the other (HMPV) and is essential for detectable replication in vivo by one virus (RSV) but is dispensable and a useful method of attenuation for the other (HMPV) are major differences that substantially impact vaccine design. In this regard, if one assumed that RSV was a predictive model, one would have emphasized the use of G protein in any vaccine (and indeed at least commercial company has based an experimental RSV vaccine solely on G). Obviously, this presumption would have been calamitous for an HMPV vaccine program. This illustrates why experienced workers in the field

recognize the need to evaluate each attenuating mutation made in HMPV as being novel.

14. At the present time, the M2-2 deletion in HMPV and RSV has some similarities but also has differences. Both yield viable virus. However, the kinetics of replication in vitro of the RSV M2-2 deletion mutant were substantially reduced compared to wild type RSV, whereas the efficiency of replication of the HMPV M2-2 deletion mutant was the same or greater than that of wild type HMPV in Vero cells (that lack the type I interferon genes). That would be a very unexpected result for one anticipating that RSV would be an accurate predictive model for HMPV, and might suggest that the M2-2 deletion was not attenuating in HMPV. Transcription seems to be up-regulated in both viruses following deletion of M2-2. However, whereas the M2-2 deletion RSV has a decrease in RNA replication associated with the increase in transcription, there does not seem to be a decrease in RNA replication with HMPV. This indicates that the mechanism of the effect is not identical. In addition, there may be a slightly higher level of point mutations with deletion of M2-2 in HMPV compared with RSV, in particular ones in runs of A's and T's. Thus, M2-2 might have an effect on the fidelity of RNA synthesis for HMPV but not RSV. There also is preliminary evidence that M2-2 is an interferon antagonist in HMPV but not RSV (which has these functions in the NS1 and NS2 proteins that HMPV lacks). If so, this would be an important difference between an M2-2 deletion virus in HMPV versus RSV, since interferon affects immunogenicity in a positive way. In practical terms, clinical results and regulatory evaluation of an RSV vaccine based on deletion of M2-2 will not be considered in any way predictive of or relevant to an HMPV vaccine based on deletion of M2-2, given the differences between the viruses and the lack of confidence in extrapolations made across viral genera.

15. Although a partial HMPV sequence was available, this is insufficient to design recombinant virus or to develop vaccine strategies. As mentioned above, the partial sequence provided by Van den Hoogen did not necessarily contain all of the HMPV genes. The sequence provided by Van den Hoogen in fact lacked the key promoter sequences. It is not an

authenticated, functional sequence, i.e., the sequence that was available had not been confirmed to encode a viable virus. This is essential given the high rate of mutation in RNA viruses. Our invention provides a complete functional sequence encoding a wild type-like virus and thus provides a working copy. In other words, one can construct a clone of that sequence and be assured that it will produce infectious virus. Our invention also establishes which proteins must be expressed in trans for recovery – this complement of proteins turns out to be different from RSV since M2-1 is not needed for HMPV replication. As already noted above, our invention also describes precise methods for recovery.

16. In summary, there are substantial differences in the biology and biochemistry of replication of HMPV compared to RSV. These differences are not known in full, since HMPV is a newly described virus and both viruses continue to be the subject of intense research. However, the differences identified to date are sufficient that the two viruses are classified in different genera. A number of specific and unexpected differences have been noted above. Contrary to the assertion of the Examiner, one of ordinary skill in the art, having before him the teachings of Bermingham regarding RSV and the sequence data and clinical information from Van den Hoogen, would **not** have a reasonable expectation of success in achieving an attenuated HMPV (claim 1) by applying the techniques of Bermingham to HMPV to make a recombinant virus that did not express a functional M2-2 protein. Some of the obstacles involve the lack of a working HMPV model, including the lack of a complete inventory of the genes, the lack of information on the specific functions of the genes, the lack of a complete confirmed sequence, and the lack of methods for recovering this slow growing and fastidious virus by recombinant methods. Other obstacles involve differences, both known and anticipated, between the viruses that preclude direct extrapolation between distinct taxonomic groups. Above, we have given examples of substantial differences in the properties of the M2-1, M2-2, and G proteins and viruses from which these genes have been deleted. Pertinent to the M2 gene, HMPV lacking functional M2-2 protein is not attenuated in cells that do not produce interferon, whereas RSV lacking functional M2-2 protein is highly attenuated in vitro regardless of interferon production. The Examiner is referred to pp. 79-80 of the specification.

This is consistent with function of the M2 proteins of HMPV as interferon antagonists. With regard to M2-1, deletion of this protein from RSV is lethal, consistent with its role as an essential transcription elongation factor. In contrast, deletion of M2-1 from HMPV is only slightly attenuating in vitro and yields a virus that appears to transcribe without impediment. It is clear that one cannot extrapolate between these two viruses. The Examiner's speculation that one could directly apply the knowledge about how to attenuate RSV to HMPV is only that. Absent the teachings of the present specification, there simply was not enough known about HMPV at the time the present invention was made to make attenuated HMPV viruses in a directed, predicable fashion using genetic engineering methods.

17. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: 11/09/07 By Peter Collins

(Dr. Peter Collins)

CURRICULUM VITAE

Name: Peter L. Collins, Ph.D.

Date and Place of Birth: June 16, 1953; New Haven, Connecticut

Citizenship: United States

Address: Home: 2921 Woodstock Avenue
Silver Spring, MD, 20910
phone: (301) 578-4111

Office: RVS/LID/NIAID/NIH
Building 50, Room 6503
50 South Drive MSC 8007
Bethesda, MD 20892-8007
phone: (301) 594-1590

e-mail: pcollins@niaid.nih.gov

Education:

1976	B.S. (Biology), University of Connecticut
1981	Ph.D. (Microbiology), University of Connecticut

Brief Chronology of Employment:

1976 - 1981	Predoctoral Fellow, Microbiology Section, Biological Sciences Group, University of Connecticut, Laboratories of Dr. L. Andrew Ball and Dr. Lawrence E. Hightower.
1981 - 1984	Postdoctoral Fellow, Department of Microbiology and Immunology, University of North Carolina School of Medicine, Laboratory of Dr. Gail W. Wertz
1984 - 1991	Senior Staff Fellow, Public Health Service, Respiratory Viruses Section, Laboratory of Infectious Diseases, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, MD
1991 -Present	Senior Investigator, Respiratory Viruses Section, Laboratory of Infectious Diseases, National Institute of

Allergy and Infectious Diseases, National Institutes of Health, Bethesda, MD

Professional Societies/Memberships:

American Society for Virology
American Society for Microbiology

Honors and Other Scientific Recognition:

Undergraduate:	State of Connecticut Scholar, Honors Scholar, Phi Beta Kappa, Faculty Scholar, University Scholar (degree *Summa Cum Laude*, 1976)
Graduate:	National Science Foundation Graduate Fellowship, National Institutes of Health Predoctoral Training Grant, GMO7219 (Individual Grant)
1981 - 1982	National Institutes of Health, Postdoctoral Fellowship, 5 F32 CAO9156-07 (Institutional Training Grant)
1982 - 1984	National Institutes of Health, Postdoctoral Fellowship, 1 F32 A106956-01 (Individual Grant)
1984	Invited instructor, Carolina Biotechnology Workshops
1986	Invited speaker, WHO Respiratory Syncytial and Parainfluenza Viruses Workshops
1986	Invited speaker, Gene Transfer and Expression Conference, Chapel Hill, North Carolina
1987	Workshop chairman, American Society for Virology
1987	Invited symposium speaker, VII International Congress for Virology
1987	Two-week training in the synthesis of synthetic peptides in the laboratory of Dr. Richard Houghten at Scripps Research Institute
1989 - Present	International Committee on Taxonomy of Viruses, Study Group on Paramyxoviridae
1990	Invited speaker, Animal Models of Respiratory Syncytial Virus Infections, Annecy, France

1991	Invited speaker, International Meetings on Biology: Workshop on Transcription and Replication of Negative Strand RNA Viruses, Madrid, Spain
1992	Invited session chairman to *Modern Approaches to Vaccines Including Prevention of Aids*, Cold Spring Harbor, New York
1993	Invited speaker and session chairman to the Juan March Foundation meeting *Reverse Genetics of Negative Stranded RNA Viruses* in Madrid
1993	Invited workshop chairman to the Ninth International Congress on Virology, August, 1993
1995	Invited Speaker, Research Triangle Virology, Chapel Hill, NC
1995	NIH Director's Award
1996	State of the Art Speaker, American Society for Virology.
1996	Keynote Speaker, European Union Third Biotechnology Meeting (Madrid).
1996	Workshop Chair, NIH Research Festival
1996-2003	Principal Investigator, CRADA entitled *Production and characterization of live attenuated RSV and PIV vaccine viruses with recombinant DNA* with Wyeth-Lederle Biologicals.
1996-1998	Co-president, NIH Virology Interest Group, 1996-1999.
1996	NIAID Director's Award
1997-2000	Co-investigator for a Civilian Research and Development Foundation Grant application with Dr. Sergey Netesov of the Vektor Laboratory, Novosibirsk, Russia
1997	Invited Speaker, *Frontiers of RNA Virus Research*, Kyoto, Japan
1997	Invited Speaker, *Current Aspects of Vaccinology and Molecular Virology* Dana Point, CA

1997	Member, Search Committee for Branch Chief, I Institute for Dental Research
1997	Invited Speaker, *Molecular Approaches to Vaccines,* Bethesda
1998	Invited Speaker, *Colloque International Vaccinologie*, l'Acadamie des Sciences et la Fondation Marcel Merieux
1999	Invited Speaker, Keystone Symposium on Viral Vaccines
1999	Invited Speaker, *Host and Viral Factors in Viral Infectivity and Pathogenicity*. Tokyo, Japan
1999	Invited Speaker, Argentine Congress of Virology, Buenos Aires
1999	Keynote speaker, "RSV after 43 Years", Indian River, FL.
2000	Chair-elect, RNA viruses Division of the American Society of Microbiology
2000	Invited Speaker, *United States Civilian Research and Development Foundation for the Independent States of the Former Soviet Union Symposium 2000*, Moscow
2000	Session chair, Negative Strand Viruses 2000, Quebec City
2000	Recipient of the Hugh Clark Distinguished Lectorship Award, University of Connecticut
2000	Recipient of Yamanouchi USA Foundation research award
2000-present	Reviewer, NIH Intramural AIDS Targeted Anti-viral Program
2001	Colloquium organizer, "Live engineered vaccines", for the 2001 American Society of Microbiology General Meeting, Orlando, FL
2001	Two keynote addresses at "RSV after 45 Years", Segovia, Spain.
2002	American Society for Microbiology Division T (RNA Viruses) Chairman

2002	Organizing committee: "Workshop on new approached for human studies to accelerate the development of a safe and effective vaccine to prevent respiratory syncytial disease
2002	Invited speaker, Juan March Foundation Meeting "Negative strand viral vectors"
2003	Invited plenary lecturer, Society for General Microbiology
2003	Instructor, United States Patent and Trademark Office Technology Fair
2003	Invited speaker, American Pediatric Society Annual Meeting
2003	Invited speaker, "RSV after 47 years", Stone Mountain, Georgia
2004	Session Chair, Workshop on Replication and Cell Biology of Negative Strand RNA Viruses
2005	Invited speaker, Airway Responses to Respiratory Viruses
2005	Invited speaker, NIH Research Festival
2005	Invited speaker and session chair, 2005 Respiratory Syncytial Virus Meeting, Cambridge, United Kingdom
2005	NIAID Merit Award
2006	Ad hoc reviewer for the NIAID Extramural Program
2006	Trans-NIH Research Initiative Planning Committee
2007	Invited speaker and session chair, New Cells for Vaccines

Editorial Boards

Journal of Virology	1989 – 1998, and 2003 - present
Virology	1998 – present
Journal of General Virology	1992 - 1996
Virus Research	2002 – present

Academic Activities

1986	Chairman, Ph.D. thesis committee for Robert C. Jambou, University of Maryland
1993	Outside examiner, Ph.D. thesis committee, K. H. Park, Mount Sinai School of Medicine
1994-2002	Ad hoc co-instructor in graduate virology courses, University of Maryland and Uniformed Services University
1994-1997	Adjunct Assistant Professor, University of Maryland
1994	Outside examiner, Ph.D. thesis committee for Tina M. Meyers, University of Florida
1997-1998	Adjunct Associate Professor, University of Maryland at College Park
1998-2006	Adjunct Professor, University of Maryland at College Park (terminated to avoid conflict of interest issues)
1995-1998	Ph.D. thesis committee for Manoj K. Pastey, University of Maryland
1998-2000	Ph. D. thesis committee for Yunus S. Abdul, University of Maryland
1998-2003	Ph.D. thesis committee for Zhuhui Huang, University of Maryland
2002-2005	Ph.D. thesis committee for Govindarajan Dhanasekaran, University of Maryland

Previous Postdoctoral Trainees

Melaine K. Spriggs, retired from Department of Molecular Biology, Immunex Corp. (now Amgen, Inc.), Seattle, WA

Robert A. Olmsted, Vice President of Research, AlphaVax, Inc. Research Triangle Park, NC

Philip R. Johnson, Chief Scientific Officer and Senior Vice President for Research at the Children's Hospital of Philadelphia

David S. Stec, Associate in the Biotechnology Patent Group of Dorsey, Dorsey and Whitney LLP, San Francisco, CA

Michael Mink, Scientist, Trimeris, Inc. Durham, NC

Geoffrey Cole, NIAID Extramural Administration, Bethesda, MD

Lili Kuo, Scientist, New York State Department of Health, Albany, NY

Prabha Atreya, CBER, FDA, Bethesda, MD

Rachel Fearns, Assistant Professor, University of Dundee, UK

Michael N. Teng, Assistant Professor, Penn State University, PA

Christine D. Krempl, Research Assistant Professor, Institute for Medicine, Freiburg, Germany

Alison Bermingham, Tenured Scientist, Central Public Health Laboratory, London, UK

Kirsten Spann, Respiratory Virus Research Unit Head, University of Queensland and Sir Albert Sakzewski Virus Research Center, Queensland, Australia

Stephane Biacchesi, Tenured Scientist and Group Leader, Unit of Molecular Virology and Immunology, INRA, Paris, France

Previous Sabbatical Professors

Kenneth Dimock, University of Ottawa, Ottawa, Canada

Haim Grosfeld, Israel Institute for Biological Research, Ness-Ziona, Israel

Juan Cristina, University of the Republic, Montevideo, Uruguay

Siba K. Samal, Virginia-Maryland Regional College of Veterinary Medicine, College Park, MD

Mark E. Peeples, Columbus Children's Research Institute, Columbus OH

Patents

1. Title: Vaccines for human respiratory syncytial virus
Inventors: Peter L. Collins and Gail W. Wertz
Number: 5,149,650
Issued: 09/22/92

2. Title: Human respiratory syncytial virus preparations and processes

Inventors: Peter L. Collins and Gail W. Wertz
Number: 5,716,832
Issued: 02/10/98

3. Title: Production of attenuated respiratory syncytial virus vaccines from cloned nucleotide sequences
Inventors: Brian R. Murphy, Peter L. Collins, Stephen S. Whitehead, Alexander A. Bukreyev, Katalin Juhasz, Michael N. Teng
Number: 5,993,824
Issued: 11/30/99

4. Title: Production of infectious respiratory syncytial virus from cloned nucleotide sequences
Inventor: Peter L. Collins
Number: 6,264,957
Issued: 07/24/01

5. Title: Detection of negative-strand RNA viruses
Inventors: Paul D. Olivo, Sondra Schlesinger, Mark E. Peeples, and Peter L. Collins
Number 6,270,958
Issued: 08/07/01

6. Title: Recombinant parainfluenza virus vaccines attenuated by deletion or ablation of a non-essential gene
Inventors: Anna P. Durbin, Peter L. Collins and Brian R. Murphy
Number: 6,410,023
Issued: 06/25/02

7. Title: Production of attenuated chimeric respiratory syncytial virus vaccines from cloned nucleotide sequences.
Inventors: Peter Collins, Brian Murphy and Stephen Whitehead
Number: 6,689,367
Issued: 02/10/04

8. Title: Production of recombinant respiratory syncytial viruses expressing immunomodulatory molecules
Inventors: Peter Collins, Alexander Bukreyev, Brian Murphy and Stephen Whitehead
Number: 6,699,476
Issued: 03/02/04

9. Title: Production of attenuated respiratory syncytial virus vaccines involving modification of M2 ORF2
Inventors: Peter Collins, Brian Murphy and Alison Bermingham
Number: 6,713,066
Issued: 03/30/04

10. Title:	Methods for producing self-replicating RSV particles comprising recombinant RSV genomes or antigenomes and the N, P, L, and M2 proteins
Inventor:	Peter L. Collins
Number:	6,790,449
Issued:	09/14/04
11. Title:	Respiratory syncytial virus vaccines expressing protective antigens from promoter-proximal genes
Inventors:	Christine D. Krempl, Peter L. Collins, Brian R. Murphy, Ursula J. Buchholz, and Stephen S. Whitehead
Number:	6,923,971
Issued:	08/02/05
12. Title:	Use of recombinant parainfluenza viruses (PIVs) as vectors to protect against infection and disease caused by PIV and other human pathogens
Inventors:	Brian R. Murphy, Peter L. Collins, Alexander C. Schmidt, Anna P. Durbin, Mario H. Skiadopoulos, and Tao Tao
Number:	7,192,593
Issued:	03/20/07
13. Title:	Attenuated human-bovine chimeric parainfluenza virus (PIV) vaccines
Inventors:	Alexander C. Schmidt, Mario H. Skiadopoulos, Peter L. Collins, Brian R. Murphy, Jane E. Bailey, Peter L. Collins, Anna P. Durbin
Number:	7,201,907
Issued:	04/10/07
14. Title:	Production of attenuated parainfluenza virus vaccines from cloned nucleotides sequences
Inventors:	Brian R. Murphy, Peter L. Collins, Anna P. Durbin, Mario H. Skiadopoulos, and Tao Tao
Number :	7,208,161
Issued:	04/24/07
15. Title:	Production of novel Newcastle disease virus strains from cDNAs and improved live attenuated Newcastle disease vaccines
Inventors:	Siba Samal and Peter Collins
Number:	7,244,558
Issued:	07/17/07
Title:	Paramyxoviruses as gene transfer vectors to lung cells
Inventors:	Raymond Pickles, Liqun Zhang, Mark Peeples, Peter Collins and John Olsen
Filed:	9/27/02

Title:	Recovery of recombinant human parainfluenza virus type 1 (HPIV1) from cDNA and use of recombinant HPIV1 in immunogenic compositions and as vectors to elicit immune responses against PIV and other human pathogens
Inventors:	Brian R. Murphy, Peter L. Collins, Mario H. Skiadopoulos and Jason T. Newman
Filed:	11/21/02
Title:	Recovery of recombinant human parainfluenza virus type 2 (HPIV2) from cDNA and use of recombinant HPIV2 as vaccines and vectors to protect against infection and disease caused by PIV and other human pathogens
Inventors:	Mario H. Skiadopoulos, Brian R. Murphy, and Peter L. Collins
Filed:	09/18/03
Title:	Production of attenuated human-bovine chimeric respiratory syncytial virus vaccines
Inventors:	Ursula J. Buchholz, Peter L. Collins, Brian R. Murphy and Stephen S. Whitehead
Filed:	06/23/00
Title:	Recombinant metapneumovirus and its use
Inventors:	Peter Collins, Stephane Biacchesi, Ursula Buchholz, Brian Murphy and Mario Skiadopoulos
Filed:	2/28/03
Title:	Attenuated human parainfluenza virus, methods and uses thereof
Inventors:	Sheila Nolan, Mario Skiadopoulos, Peter Collins and Brian Murphy

BIBLIOGRAPHY

Ph.D. Dissertation: Collins PL. Synthesis and translation of the messenger RNAs of Newcastle disease virus. 1981. Dr. L. Andrew Ball, advisor.

1. Ball LA, White CN, Collins PL. Transcription map of vesicular stomatitis virus. In Baltimore D, Huang AS, Fox CF, eds. *Animal Virology*. New York: Academic Press 1976; pp 419-438.

2. Collins PL, Hightower LE, Ball LA. Transcription and translation of Newcastle disease virus MRNAs *in vitro*. *J Virol* 1978;**28**:324-336.

3. Ball LA, Collins PL, Hightower LE. Transcription, translation and mapping of the genes of Newcastle disease virus. In Mahy BWJ, Barry RD (eds.) *Negative Strand Viruses and the Host Cell*. London: Academic Press 1978; pp 395-405.

4. Collins PL, Hightower LE, Ball LA. Transcriptional map for Newcastle disease virus. *J Virol* 1980;**35**:682-693.

5. Collins PL, Wertz GTW, Ball LA, Hightower LE. Translation of the separated messenger RNAs of Newcastle disease virus. In Bishop DHL, Compans RW (eds.) *Replication of Negative Strand Viruses*. New York: Elsevier-North Holland 1981; pp 535-543.

6. Collins PL, Fuller FJ, Marcus PI, Hightower LE, Ball LA. Synthesis and processing of Sindbis virus nonstructural proteins *in vitro*. *Virology* 1982;**118**:367-379.

7. Collins PL, Wertz GW, Ball LA, Hightower LE. Coding assignments of the five smaller mRNAs of Newcastle disease virus. *J Virol* 1982;**43**:1024-1031.

8. Collins PL, Hightower LE. Newcastle disease virus stimulates the cellular accumulation of stress (heat shock) mRNAs and proteins. *J Virol* 1982;**44**:703-707.

9. Collins PL, Wertz GW. cDNA cloning and transcriptional mapping of nine polyadenylated RNAs encoded by the genome of human respiratory syncytial virus. *Proc Natl Acad Sci USA* 1983;**80**:3208-3212.

10. Collins PL, Huang YT, Wertz GW. Identification of a tenth mRNA for respiratory syncytial virus and assignment of polypeptides to the ten viral genes. *J Virol* 1983;**49**:572-578.

11. Collins PL, Dickens LE, Wertz GW. cDNA cloning, mapping and translation of ten respiratory syncytial virus genes. In Bishop DHL, Compans RW (eds.)

Molecular Biology of Negative Strand Viruses. New York: Academic Press 1984; pp 21-26.

12. Collins PL, Huang YT, Wertz GW. Nucleotide sequence of the gene encoding the fusion (F) glycoprotein of human respiratory syncytial virus. *Proc Natl Acad Sci USA* 1984;**81**:7683-7687.

13. Dickens LE, Collins PL, Wertz GW. Transcriptional mapping of respiratory syncytial virus. *J Virol* 1984;**52**:364-369.

14. Hightower LE, Collins PL, Smith GW. Indentification of a phospharylated nonstructural form of the P protein of Newcastle disease virus and analysis of P multimers. *J Gen Virol* 1984;**65**:1631-1636.

15. Hightower LE, Smith GW, Collins PL. How many forms of the Newcastle virus P protein are there? In: Bishop DHL, Compans RW (eds.) *Molecular Biology of Negative Strand Viruses*. New York, Academic Press 1984; pp 301-303.

16. Huang YT, Collins PL, Wertz GW.1984. Identification and characterization of an additional, seventh structural protein of respiratory syncytial virions. In Bishop DHL, Compans RW (eds.) *Molecular Biology of Negative Strand Viruses*. New York: Academic Press1984; pp 365-368.

17. Collins PL, Anderson K, Langer SJ, Wertz GW. Correct sequence for the major nucleocapsid protein mRNA of respiratory syncytial virus. *Virology* 1985;**146**:69-77.

18. Collins PL, Wertz GW. Gene products and genome organization of human respiratory syncytial (RS) virus. Cold Spring Harbor Conference, 1984. In Lerner R, Brown F, Chanock R (eds.) *Modern Approaches to Vaccines: Molecular and Chemical Basis of Resistance to Viral, Bacterial and Parasitic Diseases*. New York: Cold Spring Harbor Laboratory1985; pp 297- 301

19. Collins PL, Wertz GW. The 1A protein of human respiratory syncytial virus: nucleotide sequence of the mRNA and a related polycistronic transcript. *Virology* 1985;**141**:283-291.

20. Collins PL, Wertz GW. The envelope-associated 22k dalton protein of human respiratory syncytial virus: nucleotide sequence of the mRNA and a related polytranscript. *J Virol* 1985;**54**:65-71.

21. Collins PL, Wertz GW. Nucleotide sequence of the 1B and 1C nonstructural protein mRNAs of human respiratory syncytial virus. *Virology* 1985;**143**:442-451.

22. Huang YT, Collins PL, Wertz GW. Characterization of the proteins of human respiratory syncytial virus: identification of a fourth envelope-associated protein. *Virus Research* 1985;**2**:157-173.

23. Wertz GW, Collins PL, Gruber C, Levine S, Ball LA. Nucleotide sequence of the G protein gene of human respiratory syncytial virus reveals a novel type of viral membrane protein. *Proc Natl Acad Sci USA* 1985;**82**:4075-4079.

24. Ball LA, Young KKY, Anderson K, Collins PL, Wertz GW. Expression of the major glycoprotein G of human respiratory syncytial virus from recombinant vaccinia virus vectors. *Proc Natl Acad Sci USA* 1986;**83**:246-250.

25. Collins PL, Dickens LE, Buckler-White A, Olmsted RA, Spriggs MK, Coelingh KVW. Nucleotide sequences for the gene junctions of human respiratory syncytial virus reveal distinctive features of intergenic structure and gene order. *Proc Natl Acad Sci USA* 1986;**83**:4594-4598.

26. Olmsted RA, Elango N, Prince GA, Murphy BR, Johnson PR, Moss B, Chanock RM, Collins PL. Expression of the F glycoprotein of respiratory syncytial virus by a recombinant virus: comparison of the individual contributions of the F and G glycoproteins to host immunity. *Proc Natl Acad Sci USA* 1986;**83**:7462-7466.

27. Spriggs MK, Collins PL. Human parainfluenza virus type 3: messenger RNAs, polypeptide coding assignments, intergenic sequences and genetic map. *J Virol* 1986;**59**:646-654.

28. Spriggs MK, Olmsted RA, Venkatesan S, Coligan JE, Collins PL. Fusion glycoprotein of human parainfluenza virus type 3: nucleotide sequence of the gene, direct identification of the cleavage activation site, and comparison with other paramyxoviruses. *Virology* 1986;**152**:241-251.

29. Coelingh KL, Winter CC, Murphy BR, Rice JM, Kimball PC, Collins PL. Conserved epitopes on the hemagglutinin-neuraminidase proteins of human and bovine parainfluenza type 3 viruses: nucleotide sequence analysis of variants selected with monoclonal antibodies. *J Virol* 1986;**60**:90-96.

30. Collins PL, Wertz GW. Human respiratory syncytial virus genome and gene products. In Notkins AL, Oldstone MBA (eds.) *Concepts in Viral Pathogenesis II.* New York: Springer-Verlag 1986; pp 40-46.

31. Jambou RC, Elango N, Venkatesan S, Collins PL. Complete sequence of the major nucleoscapsid protein gene of human parainfluenza type 3 virus: comparison with other negative strand viruses. *J Gen Virol* 1986;**67**:2543-2548.

32. Spriggs MK, Collins PL. Sequence analysis of the P and C protein genes of human parainfluenza virus type 3: patterns of amino acid homology among paramyxoviral proteins. *J Gen Virol* 1986;**67**:2705-2719.

33. Coelingh KVW, Rice JM, Kimball PC, Winter CC, Murphy BR, Collins PL. Hemagglutinin-neuraminidase protein epitopes shared by human and bovine parainfluenza type 3 viruses: nucleotide sequence analysis of variants selected with monoclonal antibodies. In Mahy B, Kolakofsky D, eds. *The Biology of Negative Strand Viruses*, Chapter 52. Amsterdam: Elsevier 1987; pp 391-396.

34. Jorgenson ED, Collins PL, Lomedico PT. Cloning and nucleotide sequence of Newcastle disease virus hemagglutinin-neuraminidase mRNA: identification of a putative sialic acid binding site. *Virology* 1987;**156**:12-24.

35. Spriggs MK, Johnson PR, Collins PL. Sequence analysis of the matrix (M) protein of human parainfluenza virus type 3: extensive sequence homology among paramyxoviruses. *J Gen Virol* 1987;**68**:1491-1497.

36. Olmsted RA, Johnson PR, Prince GA, Murphy BR, Moss B, Elango N, Chanock RM, Collins PL. Immunogenicity and protective efficacy of a recombinant vaccinia virus expressing the F glycoprotein of respiratory syncytial virus. In Chanock RM, Lerner RA, Brown F, Ginsberg H (eds.) *Vaccines 87: Modern Approaches to New Vaccines Including Prevention of AIDS and Other Viral, Bacterial, and Parasitic Diseases*. New York: Cold Spring Harbor Laboratory 1987; pp 350-355.

37. Collins PL, Olmsted RA, Spriggs M, Johnson PR, Buckler-White AJ. Gene overlap and site-specific attenuation of transcription of the viral polymerase (L) gene of human respiratory syncytial virus. *Proc Natl Acad Sci USA* 1987;**84**:5134-5138.

38. Johnson PR, Spriggs MK, Olmsted RA, Collins PL. The G glycoprotein of human respiratory syncytial viruses of subgroups A and B: extensive sequence divergence between antigenically related proteins. *Proc Natl Acad Sci USA* 1987;**84**:5625-5629.

39. Johnson PR, Olmsted RA, Prince GA, Murphy BR, Alling DW, Walsh EE, Collins PL. Antigenic relatedness between the glycoproteins of human respiratory syncytial virus subgroups A and B: evaluation of the contributions of the F and G glycoproteins to immunity. *J Virol* 1987;**61**:3163-3166.

40. Spriggs M, Murphy BR, Prince GA, Olmsted RA, Collins PL. Expression of the F and HN glycoproteins of human parainfluenza virus type 3 by recombinant vaccinia viruses: contributions of the individual proteins to host immunity. *J Virol* 1987;**61**:3416-3423.

41. Coelingh KL, Murphy BR, Collins PL, Lebacq-Verheyden AM, Battey JF. Expression of biologically active and antigenically authentic parainfluenza type 3 virus hemagglutinin-neuraminidase glycoprotein by a recombinant baculovirus. *Virology* 1987;**160**:465-472.

42. Murphy BR, Prince GA, Collins PL, Coelingh KVW, Olmsted RA, Spriggs MK, Parrott RH, Kim H-W, Brandt CD, Chanock RM. Current approaches to the development of vaccines effective against parainfluenza and respiratory syncytial viruses. *Virus Res* 1988;**11**:1-15.

43. Chanock RM, Murphy BR, Collins PL, Coelingh KVW, Olmsted RA, Snyder MH, Spriggs MK, Prince GA, Moss B, Flores J, Gorziglia M, Kapikian AZ. Live viral vaccines for respiratory and enteric tract diseases. 1988; Proceedings Nobel Symposium on "The Vaccines of the Future." *Vaccine* 1988;**6**:129-133.

44. Coelingh K, Battey J, Lebacq-Verheyden A, Collins P, Murphy B. Development of live virus and subunit vaccines for parainfluenza type 3 virus. In Chanock RM, Lerner RA, Brown F, Ginsberg H (eds.) *Vaccines 88: Modern Approaches to New Vaccines Including Prevention of AIDS* Cold Spring Harbor, New York: Cold Spring Harbor Laboratory1988; pp 171-177.

45. Olmsted RA, Murphy, BR, Buller RM, London WT, Prince GA, Beeler JA, Collins PL. Evaluation in nonhuman primates of the safety, immunogenicity and efficacy of recombinant vaccinia viruses expressing the F and G glycoproteins of respiratory syncytial virus. In Chanock RM, Lerner RA, Brown F, Ginsberg H (eds.) *Vaccines 88: Modern Approaches to New Vaccines Including Prevention of AIDS.* Cold Spring Harbor, New York: Cold Spring Harbor Laboratory 1988; pp 205-210.

46. Spriggs MK, Collins PL, Tierney E, London WT, Murphy BR. Immunization with vaccinia virus recombinants that express the surface glycoproteins of human parainfluenza virus type 3 (PIV 3) protect patas monkeys against PIV 3 infection. *J Virol* 1988;**62**:1293-1296.

47. Murphy BR, Olmsted RA, Collins PL, Chanock RM, Prince GA. Passive transfer of respiratory syncytial virus (RSV) antiserum supresses the immune response to the RSV fusion (F) and large (G) glycoproteins expressed by a recombinant vaccinia virus. *J Virol* 1988;**62**:3907-310.

48. Johnson PR, Collins PL. The fusion glycoprotein of human respiratory syncytial viruses of subgroups A and B: sequence conservation provides a structural basis for antigenic relatedness. *J Gen Virol* 1988;**69**:2623-2628.

49. Olmsted RA, Buller RML, Collins PL, London WT, Beeler JA, Prince GA, Chanock RM, Murphy BR. evaluation in non-human primates of the safety,

immunogenicity and efficacy of recombinant vaccinia viruses expressing the F and G glycoproteins of respiratory syncytial virus. *Vaccine* 1988;**6**:519-524.

50. Johnson PR, Collins PL. The A and B subgroups of human respiratory syncytial virus: comparison of intergenic and gene-overlap sequences. *J Gen Virol* 1988;**69**:2901-2906.

51. Olmsted RA, Murphy BR, Lawrence LA, Elango N, Moss B, Collins PL. Processing surface expression, and immunogenicity of carboxy-terminally truncated mutants of G protein of human respiratory syncytial virus. *J Virol* 1989;**63**:411-420.

52. Olmsted RA, Collins PL. The 1A protein of respiratory syncytial virus is an integral membrane protein that accumulates as multiple, structurally distinct species. *J Virol* 1989;**63**:2019-2029.

53. Murphy BR, Olmsted RA, Collins PL, Chanock RM, Prince GA. Intranasal immunization with vaccinia-RS recombinant-viruses is superior to intradermal immunization in animals with passively acquired RS virus antibodies. In Chanock RM, Lerner RA, Brown F, Ginsberg H (eds.) *Vaccines 89: Modern Approaches to New Vaccines Including Prevention of AIDS.* New York: Cold Spring Harbor Laboratory1989; pp 501-505.

54. Johnson PR, Collins PL. The 1B, 1C and N proteins of human respiratory syncytial virus (RSV) of antigenic subgroups A and B: sequence conservation and divergence within RSV genomic RNA. *J Gen Virol* 1989; **70**:1539-1547.

55. Murphy BR, Collins PL, Lawrence L, Zubac J, Chanock RM, Prince GA. Immunosuppression of the antibody response to respiratory syncytial virus (RSV) by pre-existing serum antibodies: partial abrogation by topical infection of the respiratory tract with vaccinia virus-RSV recombinants. *J Gen Virol* 1989;**70**:2185-2190.

56. Johnson PR, Collins PL. Sequence comparison of the phosphoprotein mRNAs of antigenic subgroups A and B of human respiratory syncytial virus identifies a highly divergent domain in the predicted protein. *J Gen Virol* 1990;**71**:481-485.

57. Collins PL, Purcell RH, London WT, Lawrence LA, Chanock RM, Murphy BR. Evaluation in chimpanzees of vaccinia virus recombinants that express the surface glycoproteins of human respiratory syncytial virus. *Vaccine* 1990;**6**:164-168.

58. Collins PL, Davis AR, Lubeck MD, Mizutani S, Hung PP, Prince GA, Purcell RH, Chanock RM, Murphy BR. Evaluation of the protective efficacy of recombinant vaccinia viruses and adenoviruses that express respiratory syncytial virus glycoproteins. In Brown F, Chanock RM, Ginsberg H, Lerner RA (eds.)

Vaccines 90: Modern Approaches to New Vaccines Including Prevention of AIDS. Cold Spring Harbor, New York: Cold Spring Harbor Laboratory1990; pp 79-84.

59. Collins PL. O-glycosylation of glycoprotein G of human respiratory syncytial virus is specified within the divergent ectodomain. *J Virol* 1990; **64**:4007-4012.

60. Murphy BR, Prince GA, Lawrence LA, Croen KD, Collins PL. Detection of respiratory syncytial virus (RSV) infected cells by *in situ* hybridization in the lungs of cotton rats immunized with formalin-inactivated virus or purified RSV F and G glycoprotein subunit vaccine and challenged with RSV. *Virus Research* 1990;**16**:153-162.

61. Nicholas JA, Rubino KL, Levely ME, Adams EG, Collins PL. Cytolytic T lymphocyte responses to respiratory syncytial virus: effector cell phenotype and target proteins. *J Virol* 1990;**64**:4232-4241.

62. Spriggs MK, Collins PL. Intracellular processing and transport of NH2-terminally truncated forms of the hemagglutinin-neuraminidase type II glycoprotein. *J Cell Biol* 1990;**111**:31-44.

63. Collins PL, Olmsted RA, Johnson PR. The small hydrophobic (SH) protein of human respiratory syncytial virus: comparison between antigenic subgroups A and B. *J Gen Virol* 1990;**71**:1571-1576.

64. Gupta R, Yewdell JW, Olmsted RA, Collins PL, Bennick JR. Primary pulmonary murine cytotoxic T lymphocyte specificity in respiratory syncytial virus pneumonia. *Mol Pathogen* 1990;**9**:13-18.

65. Collins PL, Hill MG, Johnson PR. The two open reading frames of 22k mRNA of human respiratory syncytial virus: sequence comparison of antigenic subgroups A and B and expression *in vitro*. *J Gen Virol* 1990; **71**:3015-3020.

66. Collins PL. The molecular biology of human respiratory syncytial virus (RSV) of genus pneumovirus. In Kingsbury DW (ed.) *Paramyxoviruses*. New York: Plenum Publishing Corporation1991; pp 103-162.

67. Collins PL, Connors M, Chanock RM, Murphy BR. Expression of respiratory syncytial virus genes by recombinant expression vectors In Meignier B, *et al.*, (eds.) *Animal Models of Respiratory Syncytial Virus Infections*. Merieux Foundation Publication 1991; pp 137-146.

68. Collins PL, Mink MA, Stec DS. Rescue of synthetic analogs of respiratory syncytial virus genomic RNA and effect of truncations and mutations on the expression of a foreign reporter gene. *Proc Natl Acad Sci USA* 1991; **188**:9663-9667.

69. Collins PL, Mottet G. Homo-oligomerization of the hemagglutinin-neuraminidase glycoprotein of human parainfluenza virus type 3 occurs prior to the acquisition of correct intramolecular disulfide bonds and mature immunoreactivity. *J Virol* 1991;**65**:2362-2371.

70. Connors M, Collins PL, Firestone C-Y, Murphy BR. The role of individual RSV proteins in resistance to infection. In Meignier B, *et al.*, (eds.) *Animal Models of Respiratory Syncytial Virus Infections*. Merieux Foundation Publication1991; pp 53-56.

71. Connors M, Collins PL, Firestone C-Y, Murphy BR. Respiratory syncytial virus (RSV) F, G, M2 (22K), and N proteins each induce resistance to RSV challenge, but resistance induced by M2 and N proteins is relatively short-lived. *J Virol* 1991;**65**:1634-1637.

72. Hsu K-H, Lubeck MD, Davis AR, Bhat RA, Selling BH, Bhat BM, Mizutani S, Huang PP, Murphy BR, Collins PL, Chanock RM. Immunogenicity and protective efficacy of adenovirus vectored respiratory syncytial virus vaccine. In Brown F, Chanock RM, Ginsberg HS, Lerner RA (eds.) *Vaccines 91: Modern Approaches to New Vaccines Including Prevention of AIDS*. Cold Spring Harbor: Cold Spring Harbor Laboratory Press 1991; pp 293-297.

73. Kanesaki T, Murphy BR, Collins PL, Ogra PL. Effectiveness of enteric immunization in the development of secretory IgA response and the outcome of infection with respiratory syncytial virus. *J Virol* 1991;**65**:657-663.

74. Martin-Gallardo A, Fien KA, Hy BT, Farley JF, Seid R, Collins PL, Hildreth SW, Paradiso PR. Expression of the F glycoprotein gene from human respiratory syncytial virus in *Escherichia coli*: Mapping of a fusion inhibiting epitope. *Virology* 1991;**184**:428-432.

75. Mink MA, Stec DS, Collins PL. Nucleotide sequences of the 3' leader and 5' trailer regions of human respiratory syncytial virus genomic RNA. *Virology* 1991;**185**:615-624.

76. Murphy BR, Prince GA, Collins PL, Hildreth SW, Paradiso PR. Effect of passive antibody on the immune response of cotton rats to purified F and G glycoproteins of respiratory syncytial virus (RSV). *Vaccine* 1991;**9**:185-189.

77. Nicholas JA, Rubino KL, Levely ME, Meyer AL, Collins P. Cytotoxic T cell activity against the 22kd protein of human respiratory syncytial virus (RSV) is associated with a significant reduction in pulmonary RSV replication. *Virology* 1991;**182**:664 672.

78. Stec DS, Hill MG, Collins PL. Sequence analysis of the polymerase L gene of human respiratory syncytial virus and predicted phylogeny of nonsegmented negative-strand viruses. *Virology* 1991;**183**:273-287.

79. Chanock RM, Parrott RH, Connors M, Collins PL, Murphy BR. Serious respiratory tract disease caused by respiratory syncytial virus: Prospects for improved therapy and effective immunization. *Pediatrics* 1992;**90**:137-143.

80. Collins PL, Mottet G. Oligomerization and post-translational processing of glycoprotein G of human respiratory syncytial virus: Altered O-glycosylation in the presence of brefeldin A. *J Gen Virol* 1992;**73**:849-863.

81. Collins PL, Mottet G. Post-translational processing and oligomerization of the fusion F glycoprotein of human respiratory syncytial virus. *J Gen Virol* 1992;**72**:3095-3101.

82. Connors M, Collins PL, Firestone C-Y, Sotnikov AV, Waitze A, Davis AR, Hung PP, Chanock RM, Murphy BR. Cotton rats previously immunized with a chimeric RSV FG glycoprotein develop enhanced pulmonary pathology when infected with RSV, a phenomenon not encountered during immunization with vaccinia-RSV recombinants or RSV. *Vaccine* 1992;**10**:475-484.

83. Connors M, Kulkarni AB, Collins PL, Firestone C-Y, Holmes KL, Morse HC, Murphy BR. Resistance to respiratory syncytial virus (RSV) challenge induced by infection with a vaccinia virus recombinant expressing the RSV M2 protein (Vac M2) is mediated by CD8+ T cells, while that induced by Vac-F or Vac-G recombinants is mediated by antibodies. *J Virol* 1992; **66**:1277-1281.

84. Gorziglia MI, Collins PL. Intracellular amplification and expression of a synthetic analog of rotavirus genomic RNA bearing a foreign marker gene: Mapping *cis* acting nucleotides in the 3'-noncoding region. *Proc Natl Acad Sci USA* 1992;**89**:5784-5788.

85. Hsu K-HL, Lubeck MD, Davis AR, Bhat RA, Selling BH, Bhat BM, Mizutani S, Murphy BR, Collins PL, Chanock RM, Hung PP. Immunogenicity of recombinant adenovirus-respiratory syncytial virus using Ad4, Ad5, and Ad7 vectors in dogs and a chimpanzee. *J Infect Dis* 1992;**166**:769-775.

86. Murphy BR, Hall SL, Crowe J, Collins PL, Subbarao EK, Connors M, London WT, Chanock RM. The use of chimpanzees in respiratory virus research. In Erwin J, Landon JC (eds.) *Chimpanzee Conservation and Public Health: Environments for the Future*. 1992; pp 21-28.

87. Chanock RM, Parrott RH, Connors M, Collins PL, Murphy BR. Serious respiratory tract disease caused by respiratory syncytial virus: prospects for improved therapy and effective immunization. *Pediatrics* 1992;**90**:137-43.

88. Collins PL, Mink MA, Hill MG, Camargo E, Grosfeld H, Stec DS. Rescue of a 7502-nucleotide (49.3% of full-length) synthetic analog of respiratory syncytial virus genomic RNA. *J Virol* 1993;**195**:252-256.

89. Collins PL, Stec DC, Kuo L, Hill MG, Camargo E, Dimock KD, Grosfeld H, Mink MA. Rescue of synthetic helper-dependent analogs of the genomic RNAs of respiratory syncytial virus and parainfluenza virus type 3. In Brown F, Chanock RM, Ginsberg HS, Lerner RA (eds.) *Vaccines 93: Modern Approaches to New Vaccines Including Prevention of AIDS.* Cold Spring Harbor: Cold Spring Harbor Laboratory Press1993; pp 259-264.

90. Crowe JE Jr, Collins PL, London WT, Chanock RM, Murphy BR. A comparison in chimpanzees of the immunogenicity and efficacy of live attenuated respiratory syncytial virus (RSV) temperature-sensitive mutant vaccines and vaccinia virus recombinants that express the surface glycoproteins of RSV. *Vaccine* 1993;**11**:1395-1404.

91. Dimock KD, Collins PL. Rescue of synthetic analogs of genomic RNA and replicative-intermediate RNA of human parainfluenza virus type 3. *J Virol* 1993;**67**:2772-2778.

92. Gorziglia MI, Yang A-D, Collins PL. Expression of a synthetic rotavirus genomic RNA segment bearing a foreign marker gene. In Brown F, Chanock RM, Ginsberg HS, Lerner RS (eds.) *Vaccines 93: Modern Approaches to New Vaccines Including Prevention of AIDS.* Cold Spring Harbor: Cold Spring Harbor Laboratory Press 1993; pp. 265-270.

93. Martin-Gallardo A, Fleischer E, Doyle SA, Arumugham R, Collins PL, Hildreth SW, Paradiso PR. Expression of the G glycoprotein gene of human respiratory syncytial virus in *Salmonella typhimurium. J Gen Virol* 1993;**74**:453-458.

94. Collins PL, Mottet G. Membrane orientation and oligomerization of the small hydrophobic protein of human respiratory syncytial virus. *J Gen Virol* 1993;**74**:1445-1450.

95. Murphy BR, Hall SL, Kulkarni AB, Crowe JE Jr., Collins PL, Connors M, Karron RA, Chanock RM. An update on approaches to the development of respiratory syncytial virus (RSV) and parainfluenza virus type 3 (PIV3) vaccines. *Virus Res* 1994;**32**:13-36.

96. Kulkarni AB, Collins PL, Bacik I, Yewdell JW, Bennink JR, Crowe JE Jr., Murphy BR. Cytotoxic T-cells specific for a single peptide derived from the M2 protein of respiratory syncytial virus are the sole mediators of resistance induced by immunization with a M2-encoding recombinant vaccinia virus. *J Virol* 1995;**69**:1261-1264.

97. Collins PL. Respiratory syncytial virus. In Webster RG, Granoff A, eds. *Encyclopedia of Virology*, WB Saunders Co 1995;1210-1218.

98. Connors M, Crowe JEJr, Firestone C-Y, Murphy BR, Collins PL. A cold passaged, attenuated strain of human respiratory syncytial virus contains mutations in the F and L genes. *Virology* 1995;**208**:478-484.

99. Grosfeld H, Hill MG, Collins, PL. RNA replication by respiratory syncytial virus (RSV) is directed by the N, P and L proteins; transcription also occurred under these conditions but required RSV superinfection for efficient synthesis of full-length mRNA. *J Virol* 1995;**69**:5677-5686.

100. Rima B, Alexander DJ, Billeter MA, Collins PL, Kingsbury DW, Lipkind DW, Nagai Y, Orvell C, Pringle CR, ter Meulen V. In *Virus Taxonomy, Classification and Nomenclature of Viruses*, Sixth Report of the Internation Committee on Taxonomy of Viruses" FA Murphy, CM Fauquet, DHL Bishop, SA Ghabrial, AW Jarvis, GP Martelli, MA Mayo and MD Summers (eds.) Springer-Verlag, Vienna 1995; pp. 268-274.

101. Collins PL, McIntosh K, Chanock RM. Respiratory syncytial virus. In Fields et al (eds.) *Virology* Raven Press 1995; pp 1313-1352.

102. Collins PL, Chanock RM, McIntosh K. Parainfluenza viruses. In Fields et al (eds.)*Virology* Raven Press 1995; pp 1205-1242.

102. Collins PL, Hill MG, Camargo E, Grosfeld H, Chanock RM, Murphy BR. Production of infectious human respiratory syncytial virus from cloned cDNA confirms an essential role of the M2(ORF1) transcription elongation factor and provides a new capability for vaccine development. *Proc Natl Acad Sci USA* 1995;**92**:11563-11567.

103. Collins PL, Hill MG, Cristina J, Grosfeld H. Transcription elongation factor for respiratory syncytial virus, a nonsegmented negative strand RNA virus. *Proc Natl Acad Sci USA* 1996;**93**:81-85.

104. Samal SK, Collins PL. RNA replication by a respiratory syncytial virus RNA analog does not obey the "rule of six" and retains a nonviral trincleotide extension at the leader end. *J Virol* 1996;**70**:5075-5082.

105. Kuo L, Fearns R, Collins PL. The structurally diverse intergenic regions of respiratory syncytial virus do not modulate sequential transcription by a dicistronic minigenome *J Virol* 1996;**70**:6143-6150.

106. Bukreyev A, Camargo E, Collins PL. Recovery of infectious respiratory syncytial virus expressing an additional, foreign gene. *J Virol* 1996;**70**:6634 6641.

107. Crowe JE, Firestone CY, Whitehead, SS, Collins PL, Murphy BR. Acquisition of the ts phenotype by a chemically mutagenized cold-passaged human respiratory syncytial virus vaccine candidate results from the acquisition of a single mutation in the polymerase (L) gene. *Virus Genes* 1996;**13**:269-273.

108. Kuo L, Grosfeld H, Cristina J, Hill, MG, Collins PL. Effect of mutations in the gene-start and gene-end sequence motifs on transcription of monocistronic and dicistronic minigenomes of respiratory syncytial virus. *J Virol* 1996;**70**:6892-6901.

109. Firestone C-Y, Whitehead SS, Collins PL, Murphy BR, Crowe JE. Nucleotide sequence of the respiratory syncytial virus subgroup A cold passaged (cp) temperature sensitive (ts) cpts-248/404 live attenuated virus vaccine candidate. *Virology* 1996;**225**:419-422.

110. Kuo L, Fearns R, Collins PL. Analysis of the gene-start and gene-end signals of human respiratory syncytial virus: quasi-templated initation at position 1 of the encoded mRNA. *J Virol* 1997;**71**:4944-4953.

111. Crowe JE, Collins PL, Chanock RM, Murphy BR. Vaccines against respiratory syncytial virus (RSV) and parainfluenza virus type 3 (PIV3). In Levine MM et al (eds.)*New Generation Vaccines*. Marcel Dekker, New York 1997; pp 711-725.

112. Murphy BR, and Collins PL. Current status of respiratory syncytial virus (RSV) and parainfluenza virus type 3 (PIV3) vaccine development: memorandum from a joint WHO/NIAID meeting. *Bull WHO* 1997;**75**:307-313.

113. Durbin AP, Siew JW, Murphy BR, Collins PL. Minimum requirements for transcription and RNA replication of a minigenome of human parainfluenza virus type 3. *Virology* 1997;**234**:74-83.

114. Juhasz K, Whitehead SS, Bui PT, Biggs JM, Boulanger CA, Collins PL, Murphy BR. The temperature sensitive (ts) phenotype of a cold-passaged (cp) live attenuated respiratory syncytial virus (RSV) vaccine candidate, designated cpts530, results from a single amino acid substitution in the L protein. *J Virol* 1997;**71**:5814-5819.

115. Fearns R, Peeples ME, Collins PL Increased expression of the N protein of respiratory syncytial virus stimulates minigenome replication but does not alter the balance between the synthesis of mRNA and antigenome *Virology* 1997;**236**:188-201.

116. Durbin AP, Hall S, Siew JW, Whitehead SS, Collins PL, Murphy BR. Recovery of infectious parainfluenza virus type 3 from cDNA. *Virology* 1997;**234**:74-83.

117. Bukreyev A, Whitehead SS, Murphy BR, Collins PL. Recombinant respiratory syncytial virus (RSV) from which the entire SH gene has been deleted grows efficiently in cell culture and exhibits site-specific attenuation in the respiratory tract of the mouse *J Virol* 1997;**71**:8973-8982.

118. Atreya PL, Peeples ME, Collins PL. The NS1 protein of human respiratory syncytial virus is a potent inhibitor of minigenome transcription and RNA replication. *J Virol* 1998;**72**:1452-1461.

119. Collins PL. Respiratory syncytial virus (Paramyxoviridae) In Webster RG, Granoff A, eds. *Encyclopedia of Virology* WB Saunders Co. 1999; pp 1479-1487.

120. Skiadopoulos MH, Durbin AP, Tatem JM, Wu S-L, Tao T, Collins PL, Murphy BR. Each of the three amino acid substitutions in the L polymerase protein of the human parainfluenza virus type 3 cp45 vaccine live attenuated vaccine candidate contributes to its temperature-sensitive and attenuation phenotypes. *J Virol* 1998;**72**:1762-1768.

121. Tao T, Durbin AP, Whitehead SS, Davoodi F, Collins PL, Murphy BR. Recovery of a fully-viable chimeric human parainfluenza virus (PIV) type 3 in which the hemagglutinin-neuraminidase and fusion glycoproteins have been replaced by those of PIV type 1. *J Virol* 1998;**72**:2955-2961.

122. Whitehead SS, Juhasz K, Firestone C-Y, Collins PL, Murphy BR. Recombinant respiratory syncytial virus (RSV) bearing a set of mutations from cold-passaged RSV is attenuated in chimpanzees. *J Virol* 1998;**72**:4467-4471.

123. Teng MN, Collins PL. Identification of the respiratory syncytial virus proteins required for formation and passage of helper-dependent infectious particles. *J Virol* 1998;**72**:5707-5716.

124. Yunus AS, Collins PL, Samal SK. Sequence analysis of a functional polymerase (L) gene of bovine respiratory syncytial virus: Determination of minimal trans-acting requirements for RNA replication. *J Gen Virol* 1998;**79**:2231-2238.

125. Whitehead SS, Firestone C-Y, Collins PL, Murphy BR. A single nucleotide substitution in the transcription start signal of the M2 gene of respiratory syncytial virus vaccine candidate *cpts*248/404 is the major determinant of the temperature-sensitive and attenuation phenotypes. *Virology* 1998;**247**:232-239.

126. Teng MN, Collins PL. Altered growth characteristics of recombinant respiratory syncytial viruses which do not express the NS2 protein. *J Virol* 1999;**73**:466-473.

127. Fearns R, Collins PL. Model for polymerase access to the overlapped L gene of respiratory syncytial virus. *J Virol* 1999;**73**:388-397.

128. Olivo PD, Collins PL, Peeples ME, Schlesinger S. Detection and quantitation of human respiratory syncytial virus (RSV) using minigenome cDNA and a Sindbis virus replicon: a prototype assay for negative-strand RNA viruses. *Virology* 1998;**251**:198-205.

129. Juhasz K, Whitehead SS, Boulanger CA, Firestone C-Y, Collins PL, Murphy BR. The two amino acid substitutions in the L protein of *cpts*530/1009, a live-attenuated respiratory syncytial virus candidate vaccine, are independent, temperature-sensitive and attenuation mutations. *Vaccine* 1999;**17**:1416-1424.

130. Whitehead SS, Firestone C-Y, Karron RA, Crowe JE, Collins PL, Murphy BR. Addition of a missense mutation from the L gene of respiratory syncytial virus (RSV) *cpts*530/1030 to RSV vaccine candidate *cpts*248/404 increases its attenuation and temperature sensitivity. *J Virol* 1999;**73**:871-877.

131. Collins PL, Whitehead SS, Bukreyev A, Fearns R, Teng MN, Juhasz K, Chanock RM, Murphy BR. Rational design of a live-attenuated recombinant vaccine virus for human respiratory syncytial virus. *Adv Virus Res* 1999;**54**:423-451.

132. Skiadopoulos MH, Surman S, Tatem JM, Paschalis M, Wu S-L, Udem SA, Durbin AP, Collins PL, Murphy BR. Identification of mutations contributing to the temperature-sensitive, cold-adapted, and attenuation phenotypes of the live attenuated cold-passage 45 (cp45) human parainfluenza virus 3 vaccine candidate. *J Virol* 1999;**73**:1374-1381.

133. Tao T, Skiadopoulos MH, Durbin AP, Collins PL, Murphy BR. A live attenuated chimeric recombinant parainfluenza virus (PIV) encoding the internal proteins of PIV type 3 and the surface glycoproteins of PIV type 1 induces complete resistance to PIV1 challenge and partial resistance to PIV3 challenge. *Vaccine*. 1999;**17**:1100-1108.

134. Bukreyev A, Whitehead SS, Bukreyeva N, Murphy BR, Collins PL. Interferon gamma expressed by a recombinant respiratory syncytial virus attenuates virus replication in mice without compromising immunogenicity. *Proc Natl Acad Sci USA* 1999;**96**:2367-2372.

135. Whitehead SS, Bukreyev A, Teng MN, Firestone C-Y, St. Clair M, Elkins WR, Collins PL, Murphy BR. Recombinant respiratory syncytial virus (RSV) bearing a deletion in either the NS2 or SH gene is attenuated in chimpanzees. *J Virol* 1999;**73**:3438-3442.

136. Juhasz K, Murphy BR, Collins PL. The major attenuating mutations of the respiratory syncytial virus vaccine candidate *cpts*530/1009 specify temperature-sensitive defects in transcription and replication and a non temperature sensitive alternation in mRNA termination. *J Virol* 1999;**73**:5176-5180.

137. Fearns R, Collins PL. Role of the M2-1 transcription antitermination protein of respiratory syncytial virus in sequential transcription. *J Virol* 1999;**73**:5852-5864.

138. Collins PL, Camargo E, Hill MG. Support proteins and support plasmids required for the recovery of infectious recombinant respiratory syncytial virus *Virology* 1999;**259**:251-255.

139. Skiadopoulos MH, Tao T, Surman SR, Collins PL, Murphy B. Generation of a parainfluenza virus type 1 vaccine candidate by replacing the HN and F glycoproteins of the live-attenuated PIV3 cp45 vaccine virus with their PIV1 counterparts. *Vaccine* 1999;**18**:503-510.

140. Skiadopoulos MH, Surman SR, St.Clair M, Elkins WR, Collins PL, Murphy BR. Attenuation of the recombinant human parainfluenza virus type 3 cp45 candidate vaccine virus is augmented by transfer of the respiratory syncytial virus cpts530 L polymerase mutation. *Virology* 1999;**260**:125-135.

141. Bermingham A, Collins PL. The M2-2 protein of human respiratory syncytial virus is a regulatory factor involved in the balance between RNA replication and transcription. *Proc Natl Acad Sci USA* 1999;**96**:1259-11264.

142. Durbin AP, McAuliffe JM, Collins PL, Murphy BR. Mutations in the C, D, and V open reading frames of human parainfluenza virus type 3 attenuate replication of the virus for rodents and primates. *Virology* 1999;**261**:319-330.

143. Whitehead SS, Hill MG, Firestone CY, St. Clair M, Elkins WR, Murphy BR, Collins PL. Replacement of the F and G protective surface antigens of respiratory syncytial virus subgroup A with those of subgroup B generates live attenuated RSV subgroup B vaccine candidates. *J Virol* 1999;**73**:9773-9780.

144. Bailly JE, McAuliffe JM, Skiadopoulos MH, Collins PL, and Murphy BR. Sequence determination and molecular analysis of two strains of bovine parainfluenza virus type 3 that are attenuated in primates. *Virus Genes* 2000;**20**:173-182.

145. Peeples ME and Collins PL. Mutations in the 5′-trailer region of a respiratory syncytial virus minigenome which limit RNA replication to one step. *J Virol* 2000;**74**:146-155.

146. Buchholz UJ, Schuldt K, Granzow H, Whitehead SS, Murphy BR, Collins PL. Chimeric bovine respiratory syncytial virus (BRSV) with glycoprotein gene substitutions from human respiratory syncytial virus (HRSV): effects on host range and evaluation as a live-attenuated HRSV vaccine. *J Virol* 2000;**74**:1187-1199.

147. Yunus AS, Krishnamurthy S, Pastey MK, Huang Z, Khattar SK, Collins PL, Samal SK. Rescue of a bovine respiratory syncytial virus genomic RNA analog by bovine, human and ovine respiratory syncytial viruses confirms the "functional integrity" and "cross-recognition" of BRSV cis-acting elements by HRSV and ORSV. *Arch Viriol* 1999;**21**:1977-1990.

148. Bailly JE, McAuliffe JM, Durbin AP, Elkins WR, Collins PL, Murphy BR. A recombinant human parainfluenza virus type 3 (PIV3) in which the nucleocapsid N protein has been replaced by that of bovine PIV3 is attenuated in primates. *J Virol* 2000;**74**:3188-95.

149. Tao T, Davoodi F, Cho CJ, Skiadopoulos MH, Durbin AP, Collins PL, Murphy BR. A live attenuated recombinant chimeric parainfluenza virus (PIV) candidate vaccine containing the hemagglutinin-neuraminidase and fusion glycoproteins of PIV1 and the remaining proteins from PIV3 induces resistance to PIV1 even in animals immune to PIV3. *Vaccine* 2000;**18**:1359-66.

150. Hallak LK, Collins PL, Knudson W, Peeples ME. Iduronic acid-containing glycosaminoglycans on target cells are required for efficient RSV infection. *Virology* 2000;**271**:264-75.

151. Khattar SK, Yunus AS, Collins PL, Samal SK. Mutational analysis of the bovine respiratory syncytial virus nucleocapsid protein using a minigenome system: mutations that affect encapsidation, RNA synthesis, and interaction with the phosphoprotein. *Virology* 2000;**270**:215-228.

152. Tao T, Skiadopoulos MH, Davoodi F, Riggs JM, Collins PL, Murphy BR. Replacement of the ectodomains of the hemagglutinin-neuraminidase and fusion glycoproteins of recombinant parainfluenza virus type 3 (PIV3) with their counterparts from PIV2 yields attenuated vaccine candidates. *J Virol* 2000;**74**:6448-58.

153. Durbin AP, Skiadopoulos MH, McAuliffe JM, Riggs JM, Surman SR, Collins PL, Murphy BR. Human parainfluenza virus type 3 (PIV3) expressing the hemagglutinin protein of measles virus provides a novel method for immunization against measles virus and PIV3 in early infancy. *J Virol* 2000;**74**:6821-31.

154. Fearns R, Collins PL, Peeples ME. Functional analysis of the genomic and antigenomic promoters of human respiratory syncytial virus (RSV). *J Virol* 2000;**74**:6006-14.

155. Skiadopoulos MH, Surman, SR, Durbin AP, Collins PL, Murphy BR. Long nucleotide insertions between the HN and the L protein coding regions of human parainfluenza virus type 3 yield viruses with temperature sensitive and attenuation phenotypes. *Virology* 2000;**272**:225-34.

156. Bukreyev A, Whitehead SS, Prussin C, Murphy BR, Collins PL. Effect of co-expression of IL-2 by recombinant respiratory syncytial virus on virus replication, immunogenicity and production of other cytokines. *J Virol* 2000;**74**:7151-7157.

157. Teng MN, Whitehead SS, Bermingham A, St. Claire M, Elkins WR, Murphy BR, Collins PL. Recombinant RSV that does not express the NS1 or the M2-2 protein is highly attenuated and immunogenic in chimpanzees. *J Virol* 2000;**74**:9317-21.

158. Schmidt AC, McAuliffe JM, Huang A, Surman SR, Bailly JE, Elkins WR, Collins PL, Murphy BR, Skiadopoulos MH. Bovine parainfluenza virus type 3 (BPIV3) fusion and hemagglutinin-neuraminidase glycoproteins make an important contribution to the restricted replication of BPIV3 in non-human primates. *J Virol* 2000;**74**:8922-9.

159. Hallak LK, Spilmann D, Collins PL, Peeples ME. Glycosaminoglycan sulfation requirements for respiratory syncytial virus infection. *J Virol* 2000;**15**:10508-10513.

161. Bukreyev A, Murphy BR, Collins PL. Respiratory syncytial virus can tolerate an intergenic region of at least 160 nucleotides with little effect on transcription or replication in vitro and in vivo. *J Virol* 2000; **74**:11017- 11026.

162. Schmidt AC, McAuliffe JM, Murphy BR, Collins PL. Recombinant bovine/human parainfluenza virus type 3 (B/HPIV3) expressing the respiratory syncytial virus (RSV) G and G proteins can be used to achieve simultaneous mucosal immunization against RSV and HPIV3. *J Virol* 2001; **75**:4594-4603.

163. Lamb RA, Collins PL, Kolakofsky D, Melero JA, Nagai Y, Oldstone MBA, Pringle CR, Rima BK. *Paramyxoviridae.* pp 549-561 *In*, "Virus Taxonomy" Seventh Report of the International Committee on Taxonomy of Viruses. (Eds: M.H.V. van Reggenmortel, C.M. Fauquet, D.H.L. Bishop, E.B. Carstens, M.K. Estes, S.M. Lemon, J. Maniloff, M.A. Mayo, D.J. McGeoch, C.R. Pringle, and R.B. Wickner). Academic Press, San Diego.

164. Gower TL, Peeples ME, Collins PL, Graham BS, RhoA is activated during respiratory syncytial virus infection. *Virology* 2001; **283**:188-96.

165. Chanock RM, Murphy BR, Collins PL. Parainfluenza viruses. 2001. In Knipe D et al (eds.) *Virology,* Fourth Edition, Lippincott, Williams and Wilkins, pp 1341-1379.

166. Collins PL, Chanock RM, Murphy BR. 2001. Respiratory syncytial virus. In Knipe D et al (eds.) *Virology,* Fourth Edition, Lippincott, Williams and Wilkins, pp 1443-1485.

167. Tao T, Skiadopoulos MH, Davoodi F, Surman SR, Collins PL, Murphy BR. Construction of a live-attenuated bivalent vaccine virus against human parainfluenza virus (PIV) types 1 and 2 using recombinant PIV3 backbone. *Vaccine*. 2001; **19**:3620-3631.

168. Khattar SK, Yunus AS, Collins PL, Samal SK. Deletion and substitution analysis defined regions and residues within the phosphoprotein of bovine respiratory syncytial virus that affect transcription, RNA replication, and interaction with the nucleoprotein. *Virology* 2001; **285**:253-269.

169. Sutherland KA, Collins PL, Peeples ME. Synergistic effects of gene-end signal mutations and the M2-1 protein on transcription termination by respiratory syncytial virus. *Virology* 2001; **288**:295-307.

170. Yunus AS, Khattar SK, Collins PL, Samal SK Rescue of bovine respiratory syncytial virus from cloned cDNA: entire genome sequence of BRSV strain A51908. Virus Genes 2001 **23**:157-64.

171 Teng MN, Whitehead SS, Collins PL. Contribution of the respiratory syncytial virus (RSV) G glycoprotein and its secreted and membrane-bound forms to virus replication in vitro and in vivo. *Virology* 2001 **189**:283-296.

172. Skiadopoulos MH, Surman SR, Riggs JM, Collins PL, Murphy BR. A chimeric human-bovine parainfluenza virus type 3 expressing the measles virus hemagglutinin protein is attenuated for replication and is immunogenic in rhesus monkeys. *J Virol* 2001 **75**:10498-504.

173. Bukreyev A, Belyakov IM, Berzofsky JA, Murphy BR, Collins PL. Granulocyte-macrophage colony-stimulating factor expressed by recombinant respiratory syncytial virus attenuates viral replication and increases the level of pulmonary antigen presenting cells. *J Virol* 2001 **75**:12128-12140.

174. Newman JT, Surman SS, Riggs JM, Hansen C, Collins PL, Murphy BR, Skiadopoulos MH. Sequence analysis of the Washington/1964 strain of human parainfluenza virus type 1 (HPIV1) and recovery and characterization of wild type HPIV1 produced by reverse genetics. *Virus Genes* 2002 **24**:77-92.

175. Schmidt AC, Wenzke D, McAuliffe JM, St. Claire M, Elkins WR, Murphy BR, Collins PL. Mucosal immunization of rhesus monkeys against RSV subgroup A, subgroup B and HPIV3 using a live cDNA-derived vaccine based on a host range-attenuated bovine parainfluenza virus type 3 vector backbone. *J Virol* 2002 **76**:1089-99.

176. Fearns R, Peeples ME, Collins PL. Mapping the transcription and replication promoters of respiratory syncytial virus. *J Virol* 2002 **76**:1663-72

177. Techaarpornkul S, Collins PL, Peeples ME. Respiratory syncytial virus with the fusion protein as its only viral glycoprotein is less dependent on cellular glycosaminoglycans for attachment than complete virus. *Virology* 2002 **294**:296-304.

178. Skiadopoulos MH, Surman SJ, Riggs JM, Elkins WR, St.Claire M, Nishio M. Garcin D, Kolakosky D, Collins PL, Murphy BR. Sendai virus, a murine parainfluenza virus type 1 (PIV1), replicates to a similar level as human PIV1 in the upper and lower respiratory tract of African green monkeys and chimpanzees. *Virology* 2002; **297**:153-160.

179. Zhang L, Peeples ME, Boucher RC, Collins PL, Pickles RJ. Respiratory syncytial virus infection of human airway epithelial cells is polarized, specific to ciliated cells, and without obvious cytopathology. *J Virol* 2002; **76**:5654-5666.

180. Murphy BR and Collins PL. Principles underlying the use of reverse genetics to analyze and develop live attenuated vaccines for respiratory syncytial virus and parainfluenza viruses. *J Clin Invest* 2002; **110**:21-27.

181. Collins PL and Murphy BR. Respiratory syncytial virus: reverse genetics and vaccine strategies. *Virology* 2002; **296**:204-211.

182. Teng MN and Collins PL. The central conserved cystine noose of the attachment G protein of human respiratory syncytial virus is not required for efficient viral infection in vitro or in vivo. *J Virol* 2002; **76**:6164-6171.

183. Crowe JE, Collins PL, Murphy BR. Vaccines against respiratory syncytial virus (RSV) and parainfluenza virus types 1-3 (PIV1-3). In Levine MM et al (eds.)*New Generation Vaccines*. Marcel Dekker, New York

184. Polack FP, Teng MN, Collins PL, Prince GA, Exner M, Regele H, Lirman DD, Rabold R, Hoffman SJ, Karp CL, Kleeberger SR, Wills-Karp M, Karron RA. A role for immune complexes in enhanced respiratory syncytial virus disease. *J Exp Med* 2002; **196**:859-865.

185. Skiadopoulos MH, Surman SR, Riggs J, Orvell C, Collins PL, Murphy BR. Evaluation of the replication and immunogenicity of recombinant human parainfluenza virus type 3 vectors expressing up to three foreign glycoproteins. *Virology* 2002; **297**:136-152.

186. Kachko AV, Sorokin AV, Belanov EF, Ivanova AV, Bukreyev AA, Collins P, Netesov SV. Study of Translation and replication of the Marburg virus system constructed based on the viral genome. *Biochem Biophys Mol Biol (Russian)* 2002; **383**:409-413.

187. Krempl C, Murphy BR, Collins PL. Recombinant respiratory syncytial virus with the G and F genes shifted to the promoter-proximal positions. *J Virol* 2002; **76**:11931-11942.

188. Bukreyev A, Skiadopoulos MH, McAuliffe J, Murphy BR, Collins PL, Schmidt AC. More antibody with less antigen: can immunogenicity of live virus vaccines be improved? *Proc Nat Acad Sci USA* 2002; **99**:16987-16991.*

* *Selected for press release.*

189. Skiadopoulos MH, Vogel L, Riggs JM, Surman SR, Collins PL, Murphy BR. The genome length of human parainfluenza virus type 2 (HPIV2) follows the rule of six, and recombinant viruses recovered from non-polyhexameric antigenomes contain a biased distribution of correcting mutations *J Virol* 2003; **7**:270-279.

190, Young DF, Andrejeva L, Goodbourn S, Lamb RA, Collins PL, Elliot, RA and Randall RE. Virus replication in engineered human cells that do not respond to interferons *J Virol* 2003; **77**:2174-2181.

191. Skiadopoulos MH, Schmidt AC, Riggs JM, Surman SR, Elkins WR, StClaire M, Collins PL, Murphy BR. The determinants of the host-range restriction of attenuation of replication of bovine parainfluenza virus type 3 (BPIV3) in rhesus monkeys are polygenic. *Virology* 2003; **77**:1141-1148.

192. Kotelkin A, Prikhod'ko EA, Cohen JI, Collins PL, Bukreyev. Respiratory syncytial virus infection sensitizes cells to apoptosis mediated by tumor neucrosis factor-related apoptosis-inducing ligand (TRAIL). *J Virol* 2003; **77**:9156-9172.

193. Spann KM, Collins PL, Teng MN. Genetic recombination during co-infection of two mutants of human respiratory syncytial virus. *J Virol* 2003; **77**:11201-11211.

194. Biacchesi A, Skiadopoulos MH, Boivin G, Murphy BR, Collins PL, Buchholz UJ. Genetic diversity between two metapneumovirus subgroups. *Virology* 2003; **315**:1-9.

195. McAuliffe JM, Surman SR, Newman JT, Rigs JM, Collins PL, Murphy BR, and Skiadopoulos MH. Codon substitution mutations at two positions in the large polymerase protein of human parainfluenza virus type 1 yield viruses with a spectrum of attenuation *in vivo* and increased phenotypic stability *in vitro*. *J Virol* 2004; **78**:2029-2036.

196. Tran K-C, Collins PL, Teng MN. Effects of altering the transcription termination signals of respiratory syncytial virus (RSV) on viral gene expression and growth *in vitro* and *in vivo J Virol* 2004; **78**:692-699.

197. Newman JT, Riggs JM, Surman SR, McAuliffe J, Mulaikal TA, Collins PL, Murphy BR, Skiadopoulos MH. Generation of recombinant human parainfluenza virus ypye 1 vaccine candidates by importation of temperature–sensitive and attenuating mutations from heterologous paramyxoviruses *J Virol* 2004; **78**:2017-2028.

198. Biacchesi S, Skiadopoulos HM, Tran K-C, Murphy BR, Collins PL, Buchholz UJ. Recovery of human metapneumovirus from cDNA: optimization of growth in vitro and expression of additional genes *Virology* 2004; **321**:247-259.

199. Johnson, TR, Teng, MN, Collins PL, Graham BS. Respiratory syncytial virus (RSV) G glycoprotein is not necessary for vaccine-enhanced disease induced by immunization with formalin-inactivated RSV. *J Virol* 2004; **78**:6024-32.

200. Spann, KM, Tran, KC, Chi, B, Rabin, RL, Collins, PL. Suppression of the induction of IFN alpha, beta and lambda by the NS1 and NS2 proteins of human respiratory syncytial virus in human epithelial cells and macrophages. *J Virol* 2004; **78**:4363-4369.

201. Skiadopoulos, MH, Stéphane, B, Buchholz, UJ, Riggs JM, Surman, SR, Amaro-Carambot, E, McAuliffe, JM, Elkins, WR, St.Claire, Collins, PL, and Murphy BR. The two major human metapneumovirus (HMPV) genetic lineages are highly related antigenically in rodents and nonhuman primates and the fusion (F) glycoprotein is a major contributor to this antigenic relatedness. *J Virol* 2004; **78**:6927-6937.

202. Bisht H, Roberts A, Vogel L, Bukreyev A, Collins PL, Murphy B, Subbarao K, Moss B. SARS coronavirus spike protein expressed by attenuated vaccinia virus induces neutralizing antibody and protectively immunizes mice. *Proc Natl Acad Sci USA*, 2004; **101**:6641-6646*

* *Selected for press release*

203. Bukreyev A, Lamirande EW, Buchholz UJ, Vogel LN, Elkins WR, St. Claire M, Murphy BR, Subbarao K, Collins PL. Mucosal immunization of African green monkeys (*Cercopithecus aethiops)* with an attenuated parainfluenza virus expressing the SARS coronavirus spike protein for the prevention of SARS. *Lancet* 2004, **363**:2122-2127*.

* *Selected for press release*

204. Buchholz UJ, Bukreyev A, Yang L, Lamirande EW, Murphy BR, Subbarao, K, Collins PL. Contributions of the structural proteins of Severe Acute Respiratory Syndrome coronavirus to protective immunity. *Proc Natl Acad Sci USA* 2004; **101**:9804-9809*.

** Selected for press release*

205. Biacchesi S, Skiadopoulos MH, Yang L, Lamirande E, Tran KC, Murphy BR, Collins PL, and Buchholz UJ. Recombinant human metapneumovirus lacking the small hydrophobic SH and/or attachment G glycoprotein: deletion of G yields a promising vaccine candidate, *J Virol* 2004; **78**:12877-87.

206. Krempl CD, and Collins PL. Re-evaluation of the virulence of the prototypic strain 15 of pneumonia virus of mice (PVM). *J Virol* 2004; **78**:13362-5.

207. Schomacker H, Collins PL, Schmidt AC. *In silico* identification of a putative new paramyxovirus related to the Henipavirus genus. *Virology* 2004; **330**:178-85.

208. Zhang L., Bukreyev A, Thompson C, Peeples ME, Watson B, Collins PL, Pickles RJ. Infection of ciliated cells by human parainfluenza virus type 3 in an *in vitro* model of human airway epithelium. *J Virol* 2005; **79**:1113-24.

209. Krempl CD, Lamirande EW, Collins PL. Complete sequence of the RNA genome of pneumonia virus of mice (PVM) *Virus Genes* 2005; 30:237-248.

210. McGiven DR, Collins PL, Fearns R. Identification of internal sequences in the 3′ leader region of human respiratory syncytial virus that enhance transcription and confer replication processivity. *J Virol* 2005 79:2449-2460.

211. Karron RA, Wright PW, Belshe RB, Thumar B, Casey R, Newman F, Polack FP, Randolph VB, Deatly A, Hackell J, Gruber W, Murphy BR, Collins PL. Identification of a recombinant live-attenuated respiratory syncytial virus vaccine candidate that is highly attenuated in infants. *J Infect Dis* 2005; 191:1093-1104.

212. Spann KM, Tran KC, Collins PL. Effects of nonstructural proteins NS1 and NS2 of human respiratory syncytial virus on regulatory factor 3, NF-kappaB and expression of pro-inflammatory chemokines. *J Virol* 2005; 79:5353-5362.

213. Gower TL, Pastey MK, Peeples ME, Collins PL, McCurdy LH, Hart TK, Gurth A, Johnson TR, Graham BS. RhoA signaling is required for respiratory syncytial virus-induced syncytium formation and filamentous virus morphology. *J Virol* 2005; 79:5326-5336.

214. Bartlett EJ, Amaro-Carambot E, Surman SR, Newman JT, Collins PL, Murphy BR, Skiadopoulos MH. Human parainfluenza virus type 1 (HPIV1) vaccine candidates designed by reverse genetics are attenuated and efficacious in African green monkeys. *Vaccine* 2005; 23:4631-4646.

215. Buchholz UJ, Biacchesi S, Pham QN, Tran KC, Yang L, Luongo CL, Skiadopoulos MH, Murphy BR, Collins PL. Deletion of M2 gene open reading frames 1 and 2 of human metapneumovirus: Effects on RNA synthesis, attenuation and immunogenicity. *J Virol* 2005; 79:6588-6597.

216. Bukreyev A, Belyakov IM, Prince GA, Yim KC, Harris KK, Berzofsky JA, Collins PL. Expression of interleukin-4 by recombinant respiratory syncytial virus is associated with accelerated inflammation and a non-functional cytotoxic T lymphocyte response following primary infection but not following challenge with wild-type virus. *J Virol* 2005; 79:9515-9526*

**selected for J Virol spotlight and Faculty of 1000*

217. Lamb, R.A., P.L. Collins, D. Kolakofsky, J.A. Melero, Y. Nagai, M.B.A. Oldstone, C.R. Pringle and B.K. Rima. 2005. *Paramyxoviridae In,* "Virus Taxonomy," Eighth Report of the International Committee on Taxonomy of Viruses, (eds. C. M. Fauquet, M.A. Mayo, J. Maniloff, U. Desselberger, and L.A. Ball), pp. 655-668. Elsevier/Academic Press, London.

218. Collins PL and Murphy BR. New generation live vaccines against human respiratory syncytial virus designed by reverse genetics. *Proceedings of the American Thoracic Society* 2005; 2:166-173.

219. Ghildyal R, Li D, Peroulis I, Shields B, Bardin PG, Teng MN, Collins PL, Meanger J, Mills J. Matrix protein of respiratory syncytial virus interacts with the G glycoprotein cytoplasmic domain in the cytoplasm. *J Gen Virol* 2005; 86:1879-84

220. Biacchesi S, Skiadopoulos MH, Yang Y, Murphy BR, Collins PL, and Buchholz UJ. Rapid human metapneumovirus microneutralization assay based on green fluorescent protein expression. *J Virol Methods* 2005; 128:192-197.

221. Nolan SM, Surman SR, Amaro-Carambot E, Colllins PL, Murphy BR, Skiadopoulos HM. Live-attenuated intranasal parainfluenza virus type 2 vaccine candidates developed by reverse genetics containing L polymerase mutations imported from heterologous paramyxoviruses. *Vaccine* 2005; 23:4765-4774.

222. Polack FP, Irusta PM, Hoffman SJ, Schiatti MP, Melendi GA, Delgado MF, Laham FR, Thumar B, Hendry RM, Karron RA, Collins PL, Kleeberger SR. The cysteine-rich region of the respiratory syncytial virus attachment protein inhibits the innate immune response elicited by the virus and endotoxin. *Proc Natl Acad Sci USA* 2005; 102:8996-9001.

223. Biacchesi S, Pham QN, Skiadopoulos MH, Murphy BR, Collins PL, Buchholz UJ. Infection of non-human primates with recombinant human metapneumovirus lacking the SH, G or M2-2 protein catagorizes each as a nonessential accessory protein and identified promising vaccine candidates. *J Virol* 2005; 79:12608-12613.*

**selected for J Virol spotlight*

224. Bukreyev A., Huang Z, Yang L, Subbiah E, St. Claire M, Murphy BR, Samal SK, Collins PL. Recombinant Newcastle disease virus expressing a foreign viral antigen is attenuated and highly immunogenic in primates. *J Virol* 2005; 799:13275-84.

225. Tarran R, Button B, Picher M, Paradiso AM, Ribeiro CM, Lazarowski ER, Zhang L, Collins PL, Pickles RJ, Fredburg JJ, Boucher RC. Normal and cystic fibrosis airway surface liquid homeostatis: the effects of phasic shear stress and viral infections. *J Biol Chem* 2005; 280:35751-9.

226. Wright PF, Karron RA, Madi SA, Treanor JJ, King JC, O'Shea A, Ikizler MR, Zhu Y, Collins PL, Randolph VB, Deatly A, Gruber WC, Murphy BR. The interferon antagonist NS2 protein of respiratory syncytial virus is an important virulence determinant in humans. *J Infect Dis* 2006; 193: 573-81

227. Bartlett EJ, Amaro-Carambot E, Surman SJ, Collins PL, Murphy BR, and Skiadopoulos MH. Introducing mutations into the P/C gene of human parainfluenza virus type 1 (HPIV1) by reverse genetics generates attenuated and efficacious vaccine candidates. *Vaccine* 2005; 24:2674-84.

228. Pham QN, Biacchesi A, Skiadopoulos MH, Murphy BR, Collins PL, and Buchholz UJ. Chimeric recombinant human metapneumoviruses with the nucleocapsid or phosphoprotein open reading frame replaced by that of avian metapneumovirus exhibit improved growth in vitro and attenuation in vivo. *J Virol* 2005; 79:15114-22.

229. Sims AC, Baric RS, Yount B, Burkett SE, Collins PL, and Pickles RJ. SARS-CoV infection of human ciliated airway epitheliumL The role of ciliated cells in viral spread in the conducting airways of the lung. *J Virol* 2005; 79:15511-24.

230. Skiadopoulos, MH, Biacchesi S, Buchholz UJ, Amaro-Carambot E, Surman SR, Collins PL, and Murphy BR. Individual contributions of the human metapneumovirus (HMPV) F, G, and SH surface glycoproteins to the induction of neutralizing antibodies and protective immunity *Virology* 2006; 345:492-501

231. Bukreyev A, Yang L, Zaki SR, Shieh W-J, Rollin PE, Murphy BR, Collins PL, and Sanchez A. A single intranasal inoculation with a paramyxovirus-vectored vaccine protects guinea pigs against a high-dose Ebola virus challenge. *J Virol* 2006; 80:2267-79.

232. Chi B, Dickensheets HL, Spann KM, Alston MA, Luongo C, Renaud J-C, Kotenko SV, Graham BS, Roederer M, Beeler JA, Donnelly RP, Collins PL, Rabin RL. IFN-α IFN-λ together mediate suppression of CD4 T cell proliferation induced by human respiratory syncytial virus. *J Virol* 2006; 80:5032-40.

233. Bukreyev A, Serra ME, Laham FR, Kleeberger SR, Collins PL, Polack FP. The cystine noose of the attachment glycoprotein of respiratory syncytial virus is critical for cytotoxic T lymphocyte responses despite lacking MHC class I-restricted epitopes. *J Virol* 2006; 80:5854-5861.*

**selected for J Virol spotlight*

234. Biacchesi S, Pham QN, Skiadopoulos MH, Murphy BR, Collins PL, Buchholz UJ. Modification of the monobasic cleavage activation site of the F0 protein of human metapneumovirus to conform to that of the furin protease does not increase replication and spread in rodents and non-human primates. *J Virol* 2006; 80:5798-5806.

235. Kotelkin A, Belyakov IM, Yang L, Berzofsky JA, Collins PL, Bukreyev. The NS2 protein of human respiratory syncytial virus suppresses the cytotoxic T cell response as a consequence of suppressing the type I interferon response. *J Virol* 2006; 80:5958-5967.

236. Van Cleve W, Amaro-Carambot E, Surman SR, Collins PL, Zoon KC, Murphy BR, Skiadopoulos MH, Bartlett EJ. Attenuating mutations in the P/C gene present in human parainfluenza virus type 1 (HPIV1) vaccine candidates affect both induction of and signaling by type I interferon (IFN) by wild type HPIV1 *Virology* 2006; 352:61-73

237. Collins PL and Murphy BR. 2006. Vaccines against human respiratory syncytial virus, 2006, pp 233-278, *In* Cane P (ed) *Respiratory Syncytial Virus*, *Perspectives in Medical Virology, vol 13*, Zuckerman A and Mushahwar I (eds), Elsevier Press/

238. Karron RA and Collins PL. 2006. Parainfluenza viruses. 2006, pp 1497-1526, *In* Knipe D and Howley P (eds.) *Virology,* Fifth Edition, Lippincott, Williams and Wilkins.

239. Collins PL, and Crowe JE Jr. 2006. Respiratory syncytial virus and metapneumovirus. 2001, pp 1601-1646, *In* Knipe D and Howley P (eds.) *Virology,* Fifth Edition, Lippincott, Williams and Wilkins.

240. Bukreyev A, Skiadopoulos MH, Murphy BR, Collins PL. Non-segmented negative stand viruses as vaccine vectors. *J Virol* 2006; 80:10293-306.*

* *Minireview*

241. Buchholz UJ, Nagashima K, Murphy BR, Collins PL. Live vaccines against human metapneumovirus designed by reverse genetics. *Expert Rev Vaccines* 2006; 5:695-706.

242. Collins PL. Respiratory syncytial virus. 2006. In Encyclopedia of Virology, in press

243. Surman SR, Collins PL, Murphy BR, Skiadopoulos MH. An improved method for recovery of recombinant paramyxovirus vaccine candidates suitable for use in clinical trials. *J Virol Meth* 2007; 141:30-33.

244. Biacchesi S, Murphy BR, Collins PL, Buchholz UJ. Frequent frame shift and point mutations in the SH gene of human metapneumovirus. *J Virol*, 2007; 81:6057-6067.

245. Bukreyev A, Rollin PE, Tate MK, Yang L, Zaki SR, Shieh W-J, Murphy BR, Collins PL, Sanchez. Successful topical respiratory tract immunization of primates against Ebola virus. *J Virol*, 2007; 81:6379-6388.

246. Di Napoli JM, Kotelkin A, Yang L, Elankumaran A, Murphy BR, Samal SK, Collins PL, Bukreyev A. Newcastle disease virus, a highly host-range-restricted virus, as a vaccine vector against emerging pathogens *Proc Natl Acad Sci USA* 2007; 104:9788-9793. *

* *Selected for press release*

247. Bartlett EJ, Castano A, Surman SR, Collins PL, Skiadopoulos MH, Murphy BR. Attenuation and efficacy of human parainfluenza virus type I (HPIV1) vaccine candidates containing stabilized mutations in the P/C and L genes. *Virol J* 2007; 4:67

248. Nolan SM, Skiadopoulos MH, Bradley K, Kim OS, Bier S, Amaro-Carambot E, Surman SR, Davis S, St Claire M, Elkins R, Collins PL, Murphy BR, Schaap-Nut A. Recombinant human parainfluenza virus type 2 vaccine candidates containing a 3′genomic promotert and L polymerase mutations are attenuated, protective, and genetically stable in non-human primates. *Vaccine* 2007; 25:6409-6422.

249. Krempl CD, Wnekowicz A, Lamirande EW, Nayebagha G, Collins PL, Buchholz UJ. Identification of a novel virulence factor in recombinant pneumonia virus of mice. *J Virol* 2007; 81:9490-501.

250. Budworth J, Abbott E, Alber DG, Carron EA, Carter MC, Chambers P, Chubb A, Cockerill S, Collins PL, Dowdell VCL, Kelsey RD, Lockyer MJ, Luongo C, Najarro P, Pickles RJ, Taylor D, Tyms S, Wilson LJ, Powell KL. R604: A novel inhibitor of respiratory syncytial virus replication. *Antimicrob Agents Chemother* 2007; in press

251. Melendi GA, Zavala F, Buchholz UJ, Boivin G, Collins PL, Kleeberger S, Polack FP. Mapping and characterization of the primary and anamnestic H-2d restricted cytotoxic T lymphocyte response in mice against human metapneumovirus. *J Virol* 2007;

252. DiNapoli JM, Yang L, Suguitan A, Elankumaran S, Doward DW, Murphy BR, Samal SK, Collins PL, Bukreyev. Immunization of primates with a Newcastle disease virus-vectored vaccine via the respiratory tract induces a high titer of serum neutralizing antibodies against highly pathogenic avian influenza virus. *J Virol* 2007

253. Wright PF, Karron RA, Belshe RB, Shi JR, Randolph VB, Collins PL, O'Shea AF, Gruber WC, Murphy BR. The absence of enhanced disease with wild-type respiratory syncytial virus infection occurring after receipt of live, attenuated, respiratory syncytial virus vaccines. *Vaccine* 2007

254. Harker J, Bukreyev A, Collins PL, Wang B, Openshaw PJM, Tregoning JS. Virally delivered cytokines alter the immune response to future lung infections. J Virol.

255. Collins PL and Graham BS. Viral and host factors in human respiratory syncytial virus pathogenesis. *J Virol* *

* *Invited Mini-review*

256. Bukreyev A and Collins PL. Advances in the development of vaccines against Marburg and Ebola viruses *Future Virology*

257. Vallbracht S, Jessen B, Mrusek S, Enders A, Collins PL, Ehl S, Krempl CD. A single viral epitope determines T cell response and disease after infection of mice with respiratory syncytial virus. *J Immunol*

CURRICULUM VITAE

Name: Peter L. Collins, Ph.D.

Date and Place of Birth: June 16, 1953; New Haven, Connecticut

Citizenship: United States

Address: Home: 2921 Woodstock Avenue
Silver Spring, MD, 20910
phone: (301) 578-4111

Office: RVS/LID/NIAID/NIH
Building 50, Room 6503
50 South Drive MSC 8007
Bethesda, MD 20892-8007
phone: (301) 594-1590

e-mail: pcollins@niaid.nih.gov

Education:

1976	B.S. (Biology), University of Connecticut
1981	Ph.D. (Microbiology), University of Connecticut

Brief Chronology of Employment:

1976 - 1981	Predoctoral Fellow, Microbiology Section, Biological Sciences Group, University of Connecticut, Laboratories of Dr. L. Andrew Ball and Dr. Lawrence E. Hightower.
1981 - 1984	Postdoctoral Fellow, Department of Microbiology and Immunology, University of North Carolina School of Medicine, Laboratory of Dr. Gail W. Wertz
1984 - 1991	Senior Staff Fellow, Public Health Service, Respiratory Viruses Section, Laboratory of Infectious Diseases, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, MD
1991 -Present	Senior Investigator, Respiratory Viruses Section, Laboratory of Infectious Diseases, National Institute of

Allergy and Infectious Diseases, National Institutes of Health, Bethesda, MD

Professional Societies/Memberships:

American Society for Virology
American Society for Microbiology

Honors and Other Scientific Recognition:

Undergraduate:	State of Connecticut Scholar, Honors Scholar, Phi Beta Kappa, Faculty Scholar, University Scholar (degree *Summa Cum Laude*, 1976)
Graduate:	National Science Foundation Graduate Fellowship, National Institutes of Health Predoctoral Training Grant, GMO7219 (Individual Grant)
1981 - 1982	National Institutes of Health, Postdoctoral Fellowship, 5 F32 CAO9156-07 (Institutional Training Grant)
1982 - 1984	National Institutes of Health, Postdoctoral Fellowship, 1 F32 A106956-01 (Individual Grant)
1984	Invited instructor, Carolina Biotechnology Workshops
1986	Invited speaker, WHO Respiratory Syncytial and Parainfluenza Viruses Workshops
1986	Invited speaker, Gene Transfer and Expression Conference, Chapel Hill, North Carolina
1987	Workshop chairman, American Society for Virology
1987	Invited symposium speaker, VII International Congress for Virology
1987	Two-week training in the synthesis of synthetic peptides in the laboratory of Dr. Richard Houghten at Scripps Research Institute
1989 - Present	International Committee on Taxonomy of Viruses, Study Group on Paramyxoviridae
1990	Invited speaker, Animal Models of Respiratory Syncytial Virus Infections, Annecy, France

1991	Invited speaker, International Meetings on Biology: Workshop on Transcription and Replication of Negative Strand RNA Viruses, Madrid, Spain
1992	Invited session chairman to *Modern Approaches to Vaccines Including Prevention of Aids*, Cold Spring Harbor, New York
1993	Invited speaker and session chairman to the Juan March Foundation meeting *Reverse Genetics of Negative Stranded RNA Viruses* in Madrid
1993	Invited workshop chairman to the Ninth International Congress on Virology, August, 1993
1995	Invited Speaker, Research Triangle Virology, Chapel Hill, NC
1995	NIH Director's Award
1996	State of the Art Speaker, American Society for Virology.
1996	Keynote Speaker, European Union Third Biotechnology Meeting (Madrid).
1996	Workshop Chair, NIH Research Festival
1996-2003	Principal Investigator, CRADA entitled *Production and characterization of live attenuated RSV and PIV vaccine viruses with recombinant DNA* with Wyeth-Lederle Biologicals.
1996-1998	Co-president, NIH Virology Interest Group, 1996-1999.
1996	NIAID Director's Award
1997-2000	Co-investigator for a Civilian Research and Development Foundation Grant application with Dr. Sergey Netesov of the Vektor Laboratory, Novosibirsk, Russia
1997	Invited Speaker, *Frontiers of RNA Virus Research*, Kyoto, Japan
1997	Invited Speaker, *Current Aspects of Vaccinology and Molecular Virology* Dana Point, CA

1997	Member, Search Committee for Branch Chief, I Institute for Dental Research
1997	Invited Speaker, *Molecular Approaches to Vaccines,* Bethesda
1998	Invited Speaker, *Colloque International Vaccinologie*, l'Acadamie des Sciences et la Fondation Marcel Merieux
1999	Invited Speaker, Keystone Symposium on Viral Vaccines
1999	Invited Speaker, *Host and Viral Factors in Viral Infectivity and Pathogenicity*. Tokyo, Japan
1999	Invited Speaker, Argentine Congress of Virology, Buenos Aires
1999	Keynote speaker, "RSV after 43 Years", Indian River, FL.
2000	Chair-elect, RNA viruses Division of the American Society of Microbiology
2000	Invited Speaker, *United States Civilian Research and Development Foundation for the Independent States of the Former Soviet Union Symposium 2000*, Moscow
2000	Session chair, Negative Strand Viruses 2000, Quebec City
2000	Recipient of the Hugh Clark Distinguished Lectorship Award, University of Connecticut
2000	Recipient of Yamanouchi USA Foundation research award
2000-present	Reviewer, NIH Intramural AIDS Targeted Anti-viral Program
2001	Colloquium organizer, "Live engineered vaccines", for the 2001 American Society of Microbiology General Meeting, Orlando, FL
2001	Two keynote addresses at "RSV after 45 Years", Segovia, Spain.
2002	American Society for Microbiology Division T (RNA Viruses) Chairman

2002	Organizing committee: "Workshop on new approached for human studies to accelerate the development of a safe and effective vaccine to prevent respiratory syncytial disease
2002	Invited speaker, Juan March Foundation Meeting "Negative strand viral vectors"
2003	Invited plenary lecturer, Society for General Microbiology
2003	Instructor, United States Patent and Trademark Office Technology Fair
2003	Invited speaker, American Pediatric Society Annual Meeting
2003	Invited speaker, "RSV after 47 years", Stone Mountain, Georgia
2004	Session Chair, Workshop on Replication and Cell Biology of Negative Strand RNA Viruses
2005	Invited speaker, Airway Responses to Respiratory Viruses
2005	Invited speaker, NIH Research Festival
2005	Invited speaker and session chair, 2005 Respiratory Syncytial Virus Meeting, Cambridge, United Kingdom
2005	NIAID Merit Award
2006	Ad hoc reviewer for the NIAID Extramural Program
2006	Trans-NIH Research Initiative Planning Committee
2007	Invited speaker and session chair, New Cells for Vaccines

Editorial Boards

Journal of Virology	1989 – 1998, and 2003 - present
Virology	1998 – present
Journal of General Virology	1992 - 1996
Virus Research	2002 – present

Academic Activities

1986	Chairman, Ph.D. thesis committee for Robert C. Jambou, University of Maryland
1993	Outside examiner, Ph.D. thesis committee, K. H. Park, Mount Sinai School of Medicine
1994-2002	Ad hoc co-instructor in graduate virology courses, University of Maryland and Uniformed Services University
1994-1997	Adjunct Assistant Professor, University of Maryland
1994	Outside examiner, Ph.D. thesis committee for Tina M. Meyers, University of Florida
1997-1998	Adjunct Associate Professor, University of Maryland at College Park
1998-2006	Adjunct Professor, University of Maryland at College Park (terminated to avoid conflict of interest issues)
1995-1998	Ph.D. thesis committee for Manoj K. Pastey, University of Maryland
1998-2000	Ph. D. thesis committee for Yunus S. Abdul, University of Maryland
1998-2003	Ph.D. thesis committee for Zhuhui Huang, University of Maryland
2002-2005	Ph.D. thesis committee for Govindarajan Dhanasekaran, University of Maryland

Previous Postdoctoral Trainees

Melaine K. Spriggs, retired from Department of Molecular Biology, Immunex Corp. (now Amgen, Inc.), Seattle, WA

Robert A. Olmsted, Vice President of Research, AlphaVax, Inc. Research Triangle Park, NC

Philip R. Johnson, Chief Scientific Officer and Senior Vice President for Research at the Children's Hospital of Philadelphia

David S. Stec, Associate in the Biotechnology Patent Group of Dorsey, Dorsey and Whitney LLP, San Francisco, CA

Michael Mink, Scientist, Trimeris, Inc. Durham, NC

Geoffrey Cole, NIAID Extramural Administration, Bethesda, MD

Lili Kuo, Scientist, New York State Department of Health, Albany, NY

Prabha Atreya, CBER, FDA, Bethesda, MD

Rachel Fearns, Assistant Professor, University of Dundee, UK

Michael N. Teng, Assistant Professor, Penn State University, PA

Christine D. Krempl, Research Assistant Professor, Institute for Medicine, Freiburg, Germany

Alison Bermingham, Tenured Scientist, Central Public Health Laboratory, London, UK

Kirsten Spann, Respiratory Virus Research Unit Head, University of Queensland and Sir Albert Sakzewski Virus Research Center, Queensland, Australia

Stephane Biacchesi, Tenured Scientist and Group Leader, Unit of Molecular Virology and Immunology, INRA, Paris, France

Previous Sabbatical Professors

Kenneth Dimock, University of Ottawa, Ottawa, Canada

Haim Grosfeld, Israel Institute for Biological Research, Ness-Ziona, Israel

Juan Cristina, University of the Republic, Montevideo, Uruguay

Siba K. Samal, Virginia-Maryland Regional College of Veterinary Medicine, College Park, MD

Mark E. Peeples, Columbus Children's Research Institute, Columbus OH

Patents

1. Title: Vaccines for human respiratory syncytial virus
Inventors: Peter L. Collins and Gail W. Wertz
Number: 5,149,650
Issued: 09/22/92

2. Title: Human respiratory syncytial virus preparations and processes

Inventors: Peter L. Collins and Gail W. Wertz
Number: 5,716,832
Issued: 02/10/98

3. Title: Production of attenuated respiratory syncytial virus vaccines from cloned nucleotide sequences
Inventors: Brian R. Murphy, Peter L. Collins, Stephen S. Whitehead, Alexander A. Bukreyev, Katalin Juhasz, Michael N. Teng
Number: 5,993,824
Issued: 11/30/99

4. Title: Production of infectious respiratory syncytial virus from cloned nucleotide sequences
Inventor: Peter L. Collins
Number: 6,264,957
Issued: 07/24/01

5. Title: Detection of negative-strand RNA viruses
Inventors: Paul D. Olivo, Sondra Schlesinger, Mark E. Peeples, and Peter L. Collins
Number 6,270,958
Issued: 08/07/01

6. Title: Recombinant parainfluenza virus vaccines attenuated by deletion or ablation of a non-essential gene
Inventors: Anna P. Durbin, Peter L. Collins and Brian R. Murphy
Number: 6,410,023
Issued: 06/25/02

7. Title: Production of attenuated chimeric respiratory syncytial virus vaccines from cloned nucleotide sequences.
Inventors: Peter Collins, Brian Murphy and Stephen Whitehead
Number: 6,689,367
Issued: 02/10/04

8. Title: Production of recombinant respiratory syncytial viruses expressing immunomodulatory molecules
Inventors: Peter Collins, Alexander Bukreyev, Brian Murphy and Stephen Whitehead
Number: 6,699,476
Issued: 03/02/04

9. Title: Production of attenuated respiratory syncytial virus vaccines involving modification of M2 ORF2
Inventors: Peter Collins, Brian Murphy and Alison Bermingham
Number: 6,713,066
Issued: 03/30/04

10. Title:	Methods for producing self-replicating RSV particles comprising recombinant RSV genomes or antigenomes and the N, P, L, and M2 proteins
Inventor:	Peter L. Collins
Number:	6,790,449
Issued:	09/14/04
11. Title:	Respiratory syncytial virus vaccines expressing protective antigens from promoter-proximal genes
Inventors:	Christine D. Krempl, Peter L. Collins, Brian R. Murphy, Ursula J. Buchholz, and Stephen S. Whitehead
Number:	6,923,971
Issued:	08/02/05
12. Title:	Use of recombinant parainfluenza viruses (PIVs) as vectors to protect against infection and disease caused by PIV and other human pathogens
Inventors:	Brian R. Murphy, Peter L. Collins, Alexander C. Schmidt, Anna P. Durbin, Mario H. Skiadopoulos, and Tao Tao
Number:	7,192,593
Issued:	03/20/07
13. Title:	Attenuated human-bovine chimeric parainfluenza virus (PIV) vaccines
Inventors:	Alexander C. Schmidt, Mario H. Skiadopoulos, Peter L. Collins, Brian R. Murphy, Jane E. Bailey, Peter L. Collins, Anna P. Durbin
Number:	7,201,907
Issued:	04/10/07
14. Title:	Production of attenuated parainfluenza virus vaccines from cloned nucleotides sequences
Inventors:	Brian R. Murphy, Peter L. Collins, Anna P. Durbin, Mario H. Skiadopoulos, and Tao Tao
Number :	7,208,161
Issued:	04/24/07
15. Title:	Production of novel Newcastle disease virus strains from cDNAs and improved live attenuated Newcastle disease vaccines
Inventors:	Siba Samal and Peter Collins
Number:	7,244,558
Issued:	07/17/07
Title:	Paramyxoviruses as gene transfer vectors to lung cells
Inventors:	Raymond Pickles, Liqun Zhang, Mark Peeples, Peter Collins and John Olsen
Filed:	9/27/02

Title:	Recovery of recombinant human parainfluenza virus type 1 (HPIV1) from cDNA and use of recombinant HPIV1 in immunogenic compositions and as vectors to elicit immune responses against PIV and other human pathogens
Inventors:	Brian R. Murphy, Peter L. Collins, Mario H. Skiadopoulos and Jason T. Newman
Filed:	11/21/02
Title:	Recovery of recombinant human parainfluenza virus type 2 (HPIV2) from cDNA and use of recombinant HPIV2 as vaccines and vectors to protect against infection and disease caused by PIV and other human pathogens
Inventors:	Mario H. Skiadopoulos, Brian R. Murphy, and Peter L. Collins
Filed:	09/18/03
Title:	Production of attenuated human-bovine chimeric respiratory syncytial virus vaccines
Inventors:	Ursula J. Buchholz, Peter L. Collins, Brian R. Murphy and Stephen S. Whitehead
Filed:	06/23/00
Title:	Recombinant metapneumovirus and its use
Inventors:	Peter Collins, Stephane Biacchesi, Ursula Buchholz, Brian Murphy and Mario Skiadopoulos
Filed:	2/28/03
Title:	Attenuated human parainfluenza virus, methods and uses thereof
Inventors:	Sheila Nolan, Mario Skiadopoulos, Peter Collins and Brian Murphy

BIBLIOGRAPHY

Ph.D. Dissertation: Collins PL. Synthesis and translation of the messenger RNAs of Newcastle disease virus. 1981. Dr. L. Andrew Ball, advisor.

1. Ball LA, White CN, Collins PL. Transcription map of vesicular stomatitis virus. In Baltimore D, Huang AS, Fox CF, eds. *Animal Virology*. New York: Academic Press 1976; pp 419-438.

2. Collins PL, Hightower LE, Ball LA. Transcription and translation of Newcastle disease virus MRNAs *in vitro*. *J Virol* 1978;**28**:324-336.

3. Ball LA, Collins PL, Hightower LE. Transcription, translation and mapping of the genes of Newcastle disease virus. In Mahy BWJ, Barry RD (eds.) *Negative Strand Viruses and the Host Cell*. London: Academic Press 1978; pp 395-405.

4. Collins PL, Hightower LE, Ball LA. Transcriptional map for Newcastle disease virus. *J Virol* 1980;**35**:682-693.

5. Collins PL, Wertz GTW, Ball LA, Hightower LE. Translation of the separated messenger RNAs of Newcastle disease virus. In Bishop DHL, Compans RW (eds.) *Replication of Negative Strand Viruses*. New York: Elsevier-North Holland 1981; pp 535-543.

6. Collins PL, Fuller FJ, Marcus PI, Hightower LE, Ball LA. Synthesis and processing of Sindbis virus nonstructural proteins *in vitro*. *Virology* 1982;**118**:367-379.

7. Collins PL, Wertz GW, Ball LA, Hightower LE. Coding assignments of the five smaller mRNAs of Newcastle disease virus. *J Virol* 1982;**43**:1024-1031.

8. Collins PL, Hightower LE. Newcastle disease virus stimulates the cellular accumulation of stress (heat shock) mRNAs and proteins. *J Virol* 1982;**44**:703-707.

9. Collins PL, Wertz GW. cDNA cloning and transcriptional mapping of nine polyadenylated RNAs encoded by the genome of human respiratory syncytial virus. *Proc Natl Acad Sci USA* 1983;**80**:3208-3212.

10. Collins PL, Huang YT, Wertz GW. Identification of a tenth mRNA for respiratory syncytial virus and assignment of polypeptides to the ten viral genes. *J Virol* 1983;**49**:572-578.

11. Collins PL, Dickens LE, Wertz GW. cDNA cloning, mapping and translation of ten respiratory syncytial virus genes. In Bishop DHL, Compans RW (eds.)

Molecular Biology of Negative Strand Viruses. New York: Academic Press 1984; pp 21-26.

12. Collins PL, Huang YT, Wertz GW. Nucleotide sequence of the gene encoding the fusion (F) glycoprotein of human respiratory syncytial virus. *Proc Natl Acad Sci USA* 1984;**81**:7683-7687.

13. Dickens LE, Collins PL, Wertz GW. Transcriptional mapping of respiratory syncytial virus. *J Virol* 1984;**52**:364-369.

14. Hightower LE, Collins PL, Smith GW. Indentification of a phospharylated nonstructural form of the P protein of Newcastle disease virus and analysis of P multimers. *J Gen Virol* 1984;**65**:1631-1636.

15. Hightower LE, Smith GW, Collins PL. How many forms of the Newcastle virus P protein are there? In: Bishop DHL, Compans RW (eds.) *Molecular Biology of Negative Strand Viruses*. New York, Academic Press 1984; pp 301-303.

16. Huang YT, Collins PL, Wertz GW.1984. Identification and characterization of an additional, seventh structural protein of respiratory syncytial virions. In Bishop DHL, Compans RW (eds.) *Molecular Biology of Negative Strand Viruses*. New York: Academic Press1984; pp 365-368.

17. Collins PL, Anderson K, Langer SJ, Wertz GW. Correct sequence for the major nucleocapsid protein mRNA of respiratory syncytial virus. *Virology* 1985;**146**:69-77.

18. Collins PL, Wertz GW. Gene products and genome organization of human respiratory syncytial (RS) virus. Cold Spring Harbor Conference, 1984. In Lerner R, Brown F, Chanock R (eds.) *Modern Approaches to Vaccines: Molecular and Chemical Basis of Resistance to Viral, Bacterial and Parasitic Diseases*. New York: Cold Spring Harbor Laboratory1985; pp 297- 301

19. Collins PL, Wertz GW. The 1A protein of human respiratory syncytial virus: nucleotide sequence of the mRNA and a related polycistronic transcript. *Virology* 1985;**141**:283-291.

20. Collins PL, Wertz GW. The envelope-associated 22k dalton protein of human respiratory syncytial virus: nucleotide sequence of the mRNA and a related polytranscript. *J Virol* 1985;**54**:65-71.

21. Collins PL, Wertz GW. Nucleotide sequence of the 1B and 1C nonstructural protein mRNAs of human respiratory syncytial virus. *Virology* 1985;**143**:442-451.

22. Huang YT, Collins PL, Wertz GW. Characterization of the proteins of human respiratory syncytial virus: identification of a fourth envelope-associated protein. *Virus Research* 1985;**2**:157-173.

23. Wertz GW, Collins PL, Gruber C, Levine S, Ball LA. Nucleotide sequence of the G protein gene of human respiratory syncytial virus reveals a novel type of viral membrane protein. *Proc Natl Acad Sci USA* 1985;**82**:4075-4079.

24. Ball LA, Young KKY, Anderson K, Collins PL, Wertz GW. Expression of the major glycoprotein G of human respiratory syncytial virus from recombinant vaccinia virus vectors. *Proc Natl Acad Sci USA* 1986;**83**:246-250.

25. Collins PL, Dickens LE, Buckler-White A, Olmsted RA, Spriggs MK, Coelingh KVW. Nucleotide sequences for the gene junctions of human respiratory syncytial virus reveal distinctive features of intergenic structure and gene order. *Proc Natl Acad Sci USA* 1986;**83**:4594-4598.

26. Olmsted RA, Elango N, Prince GA, Murphy BR, Johnson PR, Moss B, Chanock RM, Collins PL. Expression of the F glycoprotein of respiratory syncytial virus by a recombinant virus: comparison of the individual contributions of the F and G glycoproteins to host immunity. *Proc Natl Acad Sci USA* 1986;**83**:7462-7466.

27. Spriggs MK, Collins PL. Human parainfluenza virus type 3: messenger RNAs, polypeptide coding assignments, intergenic sequences and genetic map. *J Virol* 1986;**59**:646-654.

28. Spriggs MK, Olmsted RA, Venkatesan S, Coligan JE, Collins PL. Fusion glycoprotein of human parainfluenza virus type 3: nucleotide sequence of the gene, direct identification of the cleavage activation site, and comparison with other paramyxoviruses. *Virology* 1986;**152**:241-251.

29. Coelingh KL, Winter CC, Murphy BR, Rice JM, Kimball PC, Collins PL. Conserved epitopes on the hemagglutinin-neuraminidase proteins of human and bovine parainfluenza type 3 viruses: nucleotide sequence analysis of variants selected with monoclonal antibodies. *J Virol* 1986;**60**:90-96.

30. Collins PL, Wertz GW. Human respiratory syncytial virus genome and gene products. In Notkins AL, Oldstone MBA (eds.) *Concepts in Viral Pathogenesis II.* New York: Springer-Verlag 1986; pp 40-46.

31. Jambou RC, Elango N, Venkatesan S, Collins PL. Complete sequence of the major nucleoscapsid protein gene of human parainfluenza type 3 virus: comparison with other negative strand viruses. *J Gen Virol* 1986;**67**:2543-2548.

32. Spriggs MK, Collins PL. Sequence analysis of the P and C protein genes of human parainfluenza virus type 3: patterns of amino acid homology among paramyxoviral proteins. *J Gen Virol* 1986;**67**:2705-2719.

33. Coelingh KVW, Rice JM, Kimball PC, Winter CC, Murphy BR, Collins PL. Hemagglutinin-neuraminidase protein epitopes shared by human and bovine parainfluenza type 3 viruses: nucleotide sequence analysis of variants selected with monoclonal antibodies. In Mahy B, Kolakofsky D, eds. *The Biology of Negative Strand Viruses*, Chapter 52. Amsterdam: Elsevier 1987; pp 391-396.

34. Jorgenson ED, Collins PL, Lomedico PT. Cloning and nucleotide sequence of Newcastle disease virus hemagglutinin-neuraminidase mRNA: identification of a putative sialic acid binding site. *Virology* 1987;**156**:12-24.

35. Spriggs MK, Johnson PR, Collins PL. Sequence analysis of the matrix (M) protein of human parainfluenza virus type 3: extensive sequence homology among paramyxoviruses. *J Gen Virol* 1987;**68**:1491-1497.

36. Olmsted RA, Johnson PR, Prince GA, Murphy BR, Moss B, Elango N, Chanock RM, Collins PL. Immunogenicity and protective efficacy of a recombinant vaccinia virus expressing the F glycoprotein of respiratory syncytial virus. In Chanock RM, Lerner RA, Brown F, Ginsberg H (eds.) *Vaccines 87: Modern Approaches to New Vaccines Including Prevention of AIDS and Other Viral, Bacterial, and Parasitic Diseases*. New York: Cold Spring Harbor Laboratory 1987; pp 350-355.

37. Collins PL, Olmsted RA, Spriggs M, Johnson PR, Buckler-White AJ. Gene overlap and site-specific attenuation of transcription of the viral polymerase (L) gene of human respiratory syncytial virus. *Proc Natl Acad Sci USA* 1987;**84**:5134-5138.

38. Johnson PR, Spriggs MK, Olmsted RA, Collins PL. The G glycoprotein of human respiratory syncytial viruses of subgroups A and B: extensive sequence divergence between antigenically related proteins. *Proc Natl Acad Sci USA* 1987;**84**:5625-5629.

39. Johnson PR, Olmsted RA, Prince GA, Murphy BR, Alling DW, Walsh EE, Collins PL. Antigenic relatedness between the glycoproteins of human respiratory syncytial virus subgroups A and B: evaluation of the contributions of the F and G glycoproteins to immunity. *J Virol* 1987;**61**:3163-3166.

40. Spriggs M, Murphy BR, Prince GA, Olmsted RA, Collins PL. Expression of the F and HN glycoproteins of human parainfluenza virus type 3 by recombinant vaccinia viruses: contributions of the individual proteins to host immunity. *J Virol* 1987;**61**:3416-3423.

41. Coelingh KL, Murphy BR, Collins PL, Lebacq-Verheyden AM, Battey JF. Expression of biologically active and antigenically authentic parainfluenza type 3 virus hemagglutinin-neuraminidase glycoprotein by a recombinant baculovirus. *Virology* 1987;**160**:465-472.

42. Murphy BR, Prince GA, Collins PL, Coelingh KVW, Olmsted RA, Spriggs MK, Parrott RH, Kim H-W, Brandt CD, Chanock RM. Current approaches to the development of vaccines effective against parainfluenza and respiratory syncytial viruses. *Virus Res* 1988;**11**:1-15.

43. Chanock RM, Murphy BR, Collins PL, Coelingh KVW, Olmsted RA, Snyder MH, Spriggs MK, Prince GA, Moss B, Flores J, Gorziglia M, Kapikian AZ. Live viral vaccines for respiratory and enteric tract diseases. 1988; Proceedings Nobel Symposium on "The Vaccines of the Future." *Vaccine* 1988;**6**:129-133.

44. Coelingh K, Battey J, Lebacq-Verheyden A, Collins P, Murphy B. Development of live virus and subunit vaccines for parainfluenza type 3 virus. In Chanock RM, Lerner RA, Brown F, Ginsberg H (eds.) *Vaccines 88: Modern Approaches to New Vaccines Including Prevention of AIDS* Cold Spring Harbor, New York: Cold Spring Harbor Laboratory1988; pp 171-177.

45. Olmsted RA, Murphy, BR, Buller RM, London WT, Prince GA, Beeler JA, Collins PL. Evaluation in nonhuman primates of the safety, immunogenicity and efficacy of recombinant vaccinia viruses expressing the F and G glycoproteins of respiratory syncytial virus. In Chanock RM, Lerner RA, Brown F, Ginsberg H (eds.) *Vaccines 88: Modern Approaches to New Vaccines Including Prevention of AIDS.* Cold Spring Harbor, New York: Cold Spring Harbor Laboratory 1988; pp 205-210.

46. Spriggs MK, Collins PL, Tierney E, London WT, Murphy BR. Immunization with vaccinia virus recombinants that express the surface glycoproteins of human parainfluenza virus type 3 (PIV 3) protect patas monkeys against PIV 3 infection. *J Virol* 1988;**62**:1293-1296.

47. Murphy BR, Olmsted RA, Collins PL, Chanock RM, Prince GA. Passive transfer of respiratory syncytial virus (RSV) antiserum supresses the immune response to the RSV fusion (F) and large (G) glycoproteins expressed by a recombinant vaccinia virus. *J Virol* 1988;**62**:3907-310.

48. Johnson PR, Collins PL. The fusion glycoprotein of human respiratory syncytial viruses of subgroups A and B: sequence conservation provides a structural basis for antigenic relatedness. *J Gen Virol* 1988;**69**:2623-2628.

49. Olmsted RA, Buller RML, Collins PL, London WT, Beeler JA, Prince GA, Chanock RM, Murphy BR. evaluation in non-human primates of the safety,

immunogenicity and efficacy of recombinant vaccinia viruses expressing the F and G glycoproteins of respiratory syncytial virus. *Vaccine* 1988;**6**:519-524.

50. Johnson PR, Collins PL. The A and B subgroups of human respiratory syncytial virus: comparison of intergenic and gene-overlap sequences. *J Gen Virol* 1988;**69**:2901-2906.

51. Olmsted RA, Murphy BR, Lawrence LA, Elango N, Moss B, Collins PL. Processing surface expression, and immunogenicity of carboxy-terminally truncated mutants of G protein of human respiratory syncytial virus. *J Virol* 1989;**63**:411-420.

52. Olmsted RA, Collins PL. The 1A protein of respiratory syncytial virus is an integral membrane protein that accumulates as multiple, structurally distinct species. *J Virol* 1989;**63**:2019-2029.

53. Murphy BR, Olmsted RA, Collins PL, Chanock RM, Prince GA. Intranasal immunization with vaccinia-RS recombinant-viruses is superior to intradermal immunization in animals with passively acquired RS virus antibodies. In Chanock RM, Lerner RA, Brown F, Ginsberg H (eds.) *Vaccines 89: Modern Approaches to New Vaccines Including Prevention of AIDS.* New York: Cold Spring Harbor Laboratory1989; pp 501-505.

54. Johnson PR, Collins PL. The 1B, 1C and N proteins of human respiratory syncytial virus (RSV) of antigenic subgroups A and B: sequence conservation and divergence within RSV genomic RNA. *J Gen Virol* 1989; **70**:1539-1547.

55. Murphy BR, Collins PL, Lawrence L, Zubac J, Chanock RM, Prince GA. Immunosuppression of the antibody response to respiratory syncytial virus (RSV) by pre-existing serum antibodies: partial abrogation by topical infection of the respiratory tract with vaccinia virus-RSV recombinants. *J Gen Virol* 1989;**70**:2185-2190.

56. Johnson PR, Collins PL. Sequence comparison of the phosphoprotein mRNAs of antigenic subgroups A and B of human respiratory syncytial virus identifies a highly divergent domain in the predicted protein. *J Gen Virol* 1990;**71**:481-485.

57. Collins PL, Purcell RH, London WT, Lawrence LA, Chanock RM, Murphy BR. Evaluation in chimpanzees of vaccinia virus recombinants that express the surface glycoproteins of human respiratory syncytial virus. *Vaccine* 1990;**6**:164-168.

58. Collins PL, Davis AR, Lubeck MD, Mizutani S, Hung PP, Prince GA, Purcell RH, Chanock RM, Murphy BR. Evaluation of the protective efficacy of recombinant vaccinia viruses and adenoviruses that express respiratory syncytial virus glycoproteins. In Brown F, Chanock RM, Ginsberg H, Lerner RA (eds.)

Vaccines 90: Modern Approaches to New Vaccines Including Prevention of AIDS. Cold Spring Harbor, New York: Cold Spring Harbor Laboratory1990; pp 79-84.

59. Collins PL. O-glycosylation of glycoprotein G of human respiratory syncytial virus is specified within the divergent ectodomain. *J Virol* 1990; **64**:4007-4012.

60. Murphy BR, Prince GA, Lawrence LA, Croen KD, Collins PL. Detection of respiratory syncytial virus (RSV) infected cells by *in situ* hybridization in the lungs of cotton rats immunized with formalin-inactivated virus or purified RSV F and G glycoprotein subunit vaccine and challenged with RSV. *Virus Research* 1990;**16**:153-162.

61. Nicholas JA, Rubino KL, Levely ME, Adams EG, Collins PL. Cytolytic T lymphocyte responses to respiratory syncytial virus: effector cell phenotype and target proteins. *J Virol* 1990;**64**:4232-4241.

62. Spriggs MK, Collins PL. Intracellular processing and transport of NH2-terminally truncated forms of the hemagglutinin-neuraminidase type II glycoprotein. *J Cell Biol* 1990;**111**:31-44.

63. Collins PL, Olmsted RA, Johnson PR. The small hydrophobic (SH) protein of human respiratory syncytial virus: comparison between antigenic subgroups A and B. *J Gen Virol* 1990;**71**:1571-1576.

64. Gupta R, Yewdell JW, Olmsted RA, Collins PL, Bennick JR. Primary pulmonary murine cytotoxic T lymphocyte specificity in respiratory syncytial virus pneumonia. *Mol Pathogen* 1990;**9**:13-18.

65. Collins PL, Hill MG, Johnson PR. The two open reading frames of 22k mRNA of human respiratory syncytial virus: sequence comparison of antigenic subgroups A and B and expression *in vitro*. *J Gen Virol* 1990; **71**:3015-3020.

66. Collins PL. The molecular biology of human respiratory syncytial virus (RSV) of genus pneumovirus. In Kingsbury DW (ed.) *Paramyxoviruses*. New York: Plenum Publishing Corporation1991; pp 103-162.

67. Collins PL, Connors M, Chanock RM, Murphy BR. Expression of respiratory syncytial virus genes by recombinant expression vectors In Meignier B, *et al.*, (eds.) *Animal Models of Respiratory Syncytial Virus Infections*. Merieux Foundation Publication 1991; pp 137-146.

68. Collins PL, Mink MA, Stec DS. Rescue of synthetic analogs of respiratory syncytial virus genomic RNA and effect of truncations and mutations on the expression of a foreign reporter gene. *Proc Natl Acad Sci USA* 1991; **188**:9663-9667.

69. Collins PL, Mottet G. Homo-oligomerization of the hemagglutinin-neuraminidase glycoprotein of human parainfluenza virus type 3 occurs prior to the acquisition of correct intramolecular disulfide bonds and mature immunoreactivity. *J Virol* 1991;**65**:2362-2371.

70. Connors M, Collins PL, Firestone C-Y, Murphy BR. The role of individual RSV proteins in resistance to infection. In Meignier B, *et al.*, (eds.) *Animal Models of Respiratory Syncytial Virus Infections*. Merieux Foundation Publication1991; pp 53-56.

71. Connors M, Collins PL, Firestone C-Y, Murphy BR. Respiratory syncytial virus (RSV) F, G, M2 (22K), and N proteins each induce resistance to RSV challenge, but resistance induced by M2 and N proteins is relatively short-lived. *J Virol* 1991;**65**:1634-1637.

72. Hsu K-H, Lubeck MD, Davis AR, Bhat RA, Selling BH, Bhat BM, Mizutani S, Huang PP, Murphy BR, Collins PL, Chanock RM. Immunogenicity and protective efficacy of adenovirus vectored respiratory syncytial virus vaccine. In Brown F, Chanock RM, Ginsberg HS, Lerner RA (eds.) *Vaccines 91: Modern Approaches to New Vaccines Including Prevention of AIDS*. Cold Spring Harbor: Cold Spring Harbor Laboratory Press 1991; pp 293-297.

73. Kanesaki T, Murphy BR, Collins PL, Ogra PL. Effectiveness of enteric immunization in the development of secretory IgA response and the outcome of infection with respiratory syncytial virus. *J Virol* 1991;**65**:657-663.

74. Martin-Gallardo A, Fien KA, Hy BT, Farley JF, Seid R, Collins PL, Hildreth SW, Paradiso PR. Expression of the F glycoprotein gene from human respiratory syncytial virus in *Escherichia coli*: Mapping of a fusion inhibiting epitope. *Virology* 1991;**184**:428-432.

75. Mink MA, Stec DS, Collins PL. Nucleotide sequences of the 3' leader and 5' trailer regions of human respiratory syncytial virus genomic RNA. *Virology* 1991;**185**:615-624.

76. Murphy BR, Prince GA, Collins PL, Hildreth SW, Paradiso PR. Effect of passive antibody on the immune response of cotton rats to purified F and G glycoproteins of respiratory syncytial virus (RSV). *Vaccine* 1991;**9**:185-189.

77. Nicholas JA, Rubino KL, Levely ME, Meyer AL, Collins P. Cytotoxic T cell activity against the 22kd protein of human respiratory syncytial virus (RSV) is associated with a significant reduction in pulmonary RSV replication. *Virology* 1991;**182**:664 672.

78. Stec DS, Hill MG, Collins PL. Sequence analysis of the polymerase L gene of human respiratory syncytial virus and predicted phylogeny of nonsegmented negative-strand viruses. *Virology* 1991;**183**:273-287.

79. Chanock RM, Parrott RH, Connors M, Collins PL, Murphy BR. Serious respiratory tract disease caused by respiratory syncytial virus: Prospects for improved therapy and effective immunization. *Pediatrics* 1992;**90**:137-143.

80. Collins PL, Mottet G. Oligomerization and post-translational processing of glycoprotein G of human respiratory syncytial virus: Altered O-glycosylation in the presence of brefeldin A. *J Gen Virol* 1992;**73**:849-863.

81. Collins PL, Mottet G. Post-translational processing and oligomerization of the fusion F glycoprotein of human respiratory syncytial virus. *J Gen Virol* 1992;**72**:3095-3101.

82. Connors M, Collins PL, Firestone C-Y, Sotnikov AV, Waitze A, Davis AR, Hung PP, Chanock RM, Murphy BR. Cotton rats previously immunized with a chimeric RSV FG glycoprotein develop enhanced pulmonary pathology when infected with RSV, a phenomenon not encountered during immunization with vaccinia-RSV recombinants or RSV. *Vaccine* 1992;**10**:475-484.

83. Connors M, Kulkarni AB, Collins PL, Firestone C-Y, Holmes KL, Morse HC, Murphy BR. Resistance to respiratory syncytial virus (RSV) challenge induced by infection with a vaccinia virus recombinant expressing the RSV M2 protein (Vac M2) is mediated by CD8+ T cells, while that induced by Vac-F or Vac-G recombinants is mediated by antibodies. *J Virol* 1992; **66**:1277-1281.

84. Gorziglia MI, Collins PL. Intracellular amplification and expression of a synthetic analog of rotavirus genomic RNA bearing a foreign marker gene: Mapping *cis* acting nucleotides in the 3'-noncoding region. *Proc Natl Acad Sci USA* 1992;**89**:5784-5788.

85. Hsu K-HL, Lubeck MD, Davis AR, Bhat RA, Selling BH, Bhat BM, Mizutani S, Murphy BR, Collins PL, Chanock RM, Hung PP. Immunogenicity of recombinant adenovirus-respiratory syncytial virus using Ad4, Ad5, and Ad7 vectors in dogs and a chimpanzee. *J Infect Dis* 1992;**166**:769-775.

86. Murphy BR, Hall SL, Crowe J, Collins PL, Subbarao EK, Connors M, London WT, Chanock RM. The use of chimpanzees in respiratory virus research. In Erwin J, Landon JC (eds.) *Chimpanzee Conservation and Public Health: Environments for the Future*. 1992; pp 21-28.

87. Chanock RM, Parrott RH, Connors M, Collins PL, Murphy BR. Serious respiratory tract disease caused by respiratory syncytial virus: prospects for improved therapy and effective immunization. *Pediatrics* 1992;**90**:137-43.

88. Collins PL, Mink MA, Hill MG, Camargo E, Grosfeld H, Stec DS. Rescue of a 7502-nucleotide (49.3% of full-length) synthetic analog of respiratory syncytial virus genomic RNA. *J Virol* 1993;**195**:252-256.

89. Collins PL, Stec DC, Kuo L, Hill MG, Camargo E, Dimock KD, Grosfeld H, Mink MA. Rescue of synthetic helper-dependent analogs of the genomic RNAs of respiratory syncytial virus and parainfluenza virus type 3. In Brown F, Chanock RM, Ginsberg HS, Lerner RA (eds.) *Vaccines 93: Modern Approaches to New Vaccines Including Prevention of AIDS.* Cold Spring Harbor: Cold Spring Harbor Laboratory Press1993; pp 259-264.

90. Crowe JE Jr, Collins PL, London WT, Chanock RM, Murphy BR. A comparison in chimpanzees of the immunogenicity and efficacy of live attenuated respiratory syncytial virus (RSV) temperature-sensitive mutant vaccines and vaccinia virus recombinants that express the surface glycoproteins of RSV. *Vaccine* 1993;**11**:1395-1404.

91. Dimock KD, Collins PL. Rescue of synthetic analogs of genomic RNA and replicative-intermediate RNA of human parainfluenza virus type 3. *J Virol* 1993;**67**:2772-2778.

92. Gorziglia MI, Yang A-D, Collins PL. Expression of a synthetic rotavirus genomic RNA segment bearing a foreign marker gene. In Brown F, Chanock RM, Ginsberg HS, Lerner RS (eds.) *Vaccines 93: Modern Approaches to New Vaccines Including Prevention of AIDS.* Cold Spring Harbor: Cold Spring Harbor Laboratory Press 1993; pp. 265-270.

93. Martin-Gallardo A, Fleischer E, Doyle SA, Arumugham R, Collins PL, Hildreth SW, Paradiso PR. Expression of the G glycoprotein gene of human respiratory syncytial virus in *Salmonella typhimurium. J Gen Virol* 1993;**74**:453-458.

94. Collins PL, Mottet G. Membrane orientation and oligomerization of the small hydrophobic protein of human respiratory syncytial virus. *J Gen Virol* 1993;**74**:1445-1450.

95. Murphy BR, Hall SL, Kulkarni AB, Crowe JE Jr., Collins PL, Connors M, Karron RA, Chanock RM. An update on approaches to the development of respiratory syncytial virus (RSV) and parainfluenza virus type 3 (PIV3) vaccines. *Virus Res* 1994;**32**:13-36.

96. Kulkarni AB, Collins PL, Bacik I, Yewdell JW, Bennink JR, Crowe JE Jr., Murphy BR. Cytotoxic T-cells specific for a single peptide derived from the M2 protein of respiratory syncytial virus are the sole mediators of resistance induced by immunization with a M2-encoding recombinant vaccinia virus. *J Virol* 1995;**69**:1261-1264.

97. Collins PL. Respiratory syncytial virus. In Webster RG, Granoff A, eds. *Encyclopedia of Virology*, WB Saunders Co 1995;1210-1218.

98. Connors M, Crowe JEJr, Firestone C-Y, Murphy BR, Collins PL. A cold passaged, attenuated strain of human respiratory syncytial virus contains mutations in the F and L genes. *Virology* 1995;**208**:478-484.

99. Grosfeld H, Hill MG, Collins, PL. RNA replication by respiratory syncytial virus (RSV) is directed by the N, P and L proteins; transcription also occurred under these conditions but required RSV superinfection for efficient synthesis of full-length mRNA. *J Virol* 1995;**69**:5677-5686.

100. Rima B, Alexander DJ, Billeter MA, Collins PL, Kingsbury DW, Lipkind DW, Nagai Y, Orvell C, Pringle CR, ter Meulen V. In *Virus Taxonomy, Classification and Nomenclature of Viruses*, Sixth Report of the Internation Committee on Taxonomy of Viruses" FA Murphy, CM Fauquet, DHL Bishop, SA Ghabrial, AW Jarvis, GP Martelli, MA Mayo and MD Summers (eds.) Springer-Verlag, Vienna 1995; pp. 268-274.

101. Collins PL, McIntosh K, Chanock RM. Respiratory syncytial virus. In Fields et al (eds.) *Virology* Raven Press 1995; pp 1313-1352.

102. Collins PL, Chanock RM, McIntosh K. Parainfluenza viruses. In Fields et al (eds.)*Virology* Raven Press 1995; pp 1205-1242.

102. Collins PL, Hill MG, Camargo E, Grosfeld H, Chanock RM, Murphy BR. Production of infectious human respiratory syncytial virus from cloned cDNA confirms an essential role of the M2(ORF1) transcription elongation factor and provides a new capability for vaccine development. *Proc Natl Acad Sci USA* 1995;**92**:11563-11567.

103. Collins PL, Hill MG, Cristina J, Grosfeld H. Transcription elongation factor for respiratory syncytial virus, a nonsegmented negative strand RNA virus. *Proc Natl Acad Sci USA* 1996;**93**:81-85.

104. Samal SK, Collins PL. RNA replication by a respiratory syncytial virus RNA analog does not obey the "rule of six" and retains a nonviral trincleotide extension at the leader end. *J Virol* 1996;**70**:5075-5082.

105. Kuo L, Fearns R, Collins PL. The structurally diverse intergenic regions of respiratory syncytial virus do not modulate sequential transcription by a dicistronic minigenome *J Virol* 1996;**70**:6143-6150.

106. Bukreyev A, Camargo E, Collins PL. Recovery of infectious respiratory syncytial virus expressing an additional, foreign gene. *J Virol* 1996;**70**:6634 6641.

107. Crowe JE, Firestone CY, Whitehead, SS, Collins PL, Murphy BR. Acquisition of the ts phenotype by a chemically mutagenized cold-passaged human respiratory syncytial virus vaccine candidate results from the acquisition of a single mutation in the polymerase (L) gene. *Virus Genes* 1996;**13**:269-273.

108. Kuo L, Grosfeld H, Cristina J, Hill, MG, Collins PL. Effect of mutations in the gene-start and gene-end sequence motifs on transcription of monocistronic and dicistronic minigenomes of respiratory syncytial virus. *J Virol* 1996;**70**:6892-6901.

109. Firestone C-Y, Whitehead SS, Collins PL, Murphy BR, Crowe JE. Nucleotide sequence of the respiratory syncytial virus subgroup A cold passaged (cp) temperature sensitive (ts) cpts-248/404 live attenuated virus vaccine candidate. *Virology* 1996;**225**:419-422.

110. Kuo L, Fearns R, Collins PL. Analysis of the gene-start and gene-end signals of human respiratory syncytial virus: quasi-templated initation at position 1 of the encoded mRNA. *J Virol* 1997;**71**:4944-4953.

111. Crowe JE, Collins PL, Chanock RM, Murphy BR. Vaccines against respiratory syncytial virus (RSV) and parainfluenza virus type 3 (PIV3). In Levine MM et al (eds.)*New Generation Vaccines*. Marcel Dekker, New York 1997; pp 711-725.

112. Murphy BR, and Collins PL. Current status of respiratory syncytial virus (RSV) and parainfluenza virus type 3 (PIV3) vaccine development: memorandum from a joint WHO/NIAID meeting. *Bull WHO* 1997;**75**:307-313.

113. Durbin AP, Siew JW, Murphy BR, Collins PL. Minimum requirements for transcription and RNA replication of a minigenome of human parainfluenza virus type 3. *Virology* 1997;**234**:74-83.

114. Juhasz K, Whitehead SS, Bui PT, Biggs JM, Boulanger CA, Collins PL, Murphy BR. The temperature sensitive (ts) phenotype of a cold-passaged (cp) live attenuated respiratory syncytial virus (RSV) vaccine candidate, designated cpts530, results from a single amino acid substitution in the L protein. *J Virol* 1997;**71**:5814-5819.

115. Fearns R, Peeples ME, Collins PL Increased expression of the N protein of respiratory syncytial virus stimulates minigenome replication but does not alter the balance between the synthesis of mRNA and antigenome *Virology* 1997;**236**:188-201.

116. Durbin AP, Hall S, Siew JW, Whitehead SS, Collins PL, Murphy BR. Recovery of infectious parainfluenza virus type 3 from cDNA. *Virology* 1997;**234**:74-83.

117. Bukreyev A, Whitehead SS, Murphy BR, Collins PL. Recombinant respiratory syncytial virus (RSV) from which the entire SH gene has been deleted grows efficiently in cell culture and exhibits site-specific attenuation in the respiratory tract of the mouse *J Virol* 1997;**71**:8973-8982.

118. Atreya PL, Peeples ME, Collins PL. The NS1 protein of human respiratory syncytial virus is a potent inhibitor of minigenome transcription and RNA replication. *J Virol* 1998;**72**:1452-1461.

119. Collins PL. Respiratory syncytial virus (Paramyxoviridae) In Webster RG, Granoff A, eds. *Encyclopedia of Virology* WB Saunders Co. 1999; pp 1479-1487.

120. Skiadopoulos MH, Durbin AP, Tatem JM, Wu S-L, Tao T, Collins PL, Murphy BR. Each of the three amino acid substitutions in the L polymerase protein of the human parainfluenza virus type 3 cp45 vaccine live attenuated vaccine candidate contributes to its temperature-sensitive and attenuation phenotypes. *J Virol* 1998;**72**:1762-1768.

121. Tao T, Durbin AP, Whitehead SS, Davoodi F, Collins PL, Murphy BR. Recovery of a fully-viable chimeric human parainfluenza virus (PIV) type 3 in which the hemagglutinin-neuraminidase and fusion glycoproteins have been replaced by those of PIV type 1. *J Virol* 1998;**72**:2955-2961.

122. Whitehead SS, Juhasz K, Firestone C-Y, Collins PL, Murphy BR. Recombinant respiratory syncytial virus (RSV) bearing a set of mutations from cold-passaged RSV is attenuated in chimpanzees. *J Virol* 1998;**72**:4467-4471.

123. Teng MN, Collins PL. Identification of the respiratory syncytial virus proteins required for formation and passage of helper-dependent infectious particles. *J Virol* 1998;**72**:5707-5716.

124. Yunus AS, Collins PL, Samal SK. Sequence analysis of a functional polymerase (L) gene of bovine respiratory syncytial virus: Determination of minimal trans-acting requirements for RNA replication. *J Gen Virol* 1998;**79**:2231-2238.

125. Whitehead SS, Firestone C-Y, Collins PL, Murphy BR. A single nucleotide substitution in the transcription start signal of the M2 gene of respiratory syncytial virus vaccine candidate *cpts*248/404 is the major determinant of the temperature-sensitive and attenuation phenotypes. *Virology* 1998;**247**:232-239.

126. Teng MN, Collins PL. Altered growth characteristics of recombinant respiratory syncytial viruses which do not express the NS2 protein. *J Virol* 1999;**73**:466-473.

127. Fearns R, Collins PL. Model for polymerase access to the overlapped L gene of respiratory syncytial virus. *J Virol* 1999;**73**:388-397.

128. Olivo PD, Collins PL, Peeples ME, Schlesinger S. Detection and quantitation of human respiratory syncytial virus (RSV) using minigenome cDNA and a Sindbis virus replicon: a prototype assay for negative-strand RNA viruses. *Virology* 1998;**251**:198-205.

129. Juhasz K, Whitehead SS, Boulanger CA, Firestone C-Y, Collins PL, Murphy BR. The two amino acid substitutions in the L protein of *cpts*530/1009, a live-attenuated respiratory syncytial virus candidate vaccine, are independent, temperature-sensitive and attenuation mutations. *Vaccine* 1999;**17**:1416-1424.

130. Whitehead SS, Firestone C-Y, Karron RA, Crowe JE, Collins PL, Murphy BR. Addition of a missense mutation from the L gene of respiratory syncytial virus (RSV) *cpts*530/1030 to RSV vaccine candidate *cpts*248/404 increases its attenuation and temperature sensitivity. *J Virol* 1999;**73**:871-877.

131. Collins PL, Whitehead SS, Bukreyev A, Fearns R, Teng MN, Juhasz K, Chanock RM, Murphy BR. Rational design of a live-attenuated recombinant vaccine virus for human respiratory syncytial virus. *Adv Virus Res* 1999;**54**:423-451.

132. Skiadopoulos MH, Surman S, Tatem JM, Paschalis M, Wu S-L, Udem SA, Durbin AP, Collins PL, Murphy BR. Identification of mutations contributing to the temperature-sensitive, cold-adapted, and attenuation phenotypes of the live attenuated cold-passage 45 (cp45) human parainfluenza virus 3 vaccine candidate. *J Virol* 1999;**73**:1374-1381.

133. Tao T, Skiadopoulos MH, Durbin AP, Collins PL, Murphy BR. A live attenuated chimeric recombinant parainfluenza virus (PIV) encoding the internal proteins of PIV type 3 and the surface glycoproteins of PIV type 1 induces complete resistance to PIV1 challenge and partial resistance to PIV3 challenge. *Vaccine*. 1999;**17**:1100-1108.

134. Bukreyev A, Whitehead SS, Bukreyeva N, Murphy BR, Collins PL. Interferon gamma expressed by a recombinant respiratory syncytial virus attenuates virus replication in mice without compromising immunogenicity. *Proc Natl Acad Sci USA* 1999;**96**:2367-2372.

135. Whitehead SS, Bukreyev A, Teng MN, Firestone C-Y, St. Clair M, Elkins WR, Collins PL, Murphy BR. Recombinant respiratory syncytial virus (RSV) bearing a deletion in either the NS2 or SH gene is attenuated in chimpanzees. *J Virol* 1999;**73**:3438-3442.

136. Juhasz K, Murphy BR, Collins PL. The major attenuating mutations of the respiratory syncytial virus vaccine candidate *cpts*530/1009 specify temperature-sensitive defects in transcription and replication and a non temperature sensitive alternation in mRNA termination. *J Virol* 1999;**73**:5176-5180.

137. Fearns R, Collins PL. Role of the M2-1 transcription antitermination protein of respiratory syncytial virus in sequential transcription. *J Virol* 1999;**73**:5852-5864.

138. Collins PL, Camargo E, Hill MG. Support proteins and support plasmids required for the recovery of infectious recombinant respiratory syncytial virus *Virology* 1999;**259**:251-255.

139. Skiadopoulos MH, Tao T, Surman SR, Collins PL, Murphy B. Generation of a parainfluenza virus type 1 vaccine candidate by replacing the HN and F glycoproteins of the live-attenuated PIV3 cp45 vaccine virus with their PIV1 counterparts. *Vaccine* 1999;**18**:503-510.

140. Skiadopoulos MH, Surman SR, St.Clair M, Elkins WR, Collins PL, Murphy BR. Attenuation of the recombinant human parainfluenza virus type 3 cp45 candidate vaccine virus is augmented by transfer of the respiratory syncytial virus cpts530 L polymerase mutation. *Virology* 1999;**260**:125-135.

141. Bermingham A, Collins PL. The M2-2 protein of human respiratory syncytial virus is a regulatory factor involved in the balance between RNA replication and transcription. *Proc Natl Acad Sci USA* 1999;**96**:1259-11264.

142. Durbin AP, McAuliffe JM, Collins PL, Murphy BR. Mutations in the C, D, and V open reading frames of human parainfluenza virus type 3 attenuate replication of the virus for rodents and primates. *Virology* 1999;**261**:319-330.

143. Whitehead SS, Hill MG, Firestone CY, St. Clair M, Elkins WR, Murphy BR, Collins PL. Replacement of the F and G protective surface antigens of respiratory syncytial virus subgroup A with those of subgroup B generates live attenuated RSV subgroup B vaccine candidates. *J Virol* 1999;**73**:9773-9780.

144. Bailly JE, McAuliffe JM, Skiadopoulos MH, Collins PL, and Murphy BR. Sequence determination and molecular analysis of two strains of bovine parainfluenza virus type 3 that are attenuated in primates. *Virus Genes* 2000;**20**:173-182.

145. Peeples ME and Collins PL. Mutations in the 5′-trailer region of a respiratory syncytial virus minigenome which limit RNA replication to one step. *J Virol* 2000;**74**:146-155.

146. Buchholz UJ, Schuldt K, Granzow H, Whitehead SS, Murphy BR, Collins PL. Chimeric bovine respiratory syncytial virus (BRSV) with glycoprotein gene substitutions from human respiratory syncytial virus (HRSV): effects on host range and evaluation as a live-attenuated HRSV vaccine. *J Virol* 2000;**74**:1187-1199.

147. Yunus AS, Krishnamurthy S, Pastey MK, Huang Z, Khattar SK, Collins PL, Samal SK. Rescue of a bovine respiratory syncytial virus genomic RNA analog by bovine, human and ovine respiratory syncytial viruses confirms the "functional integrity" and "cross-recognition" of BRSV cis-acting elements by HRSV and ORSV. *Arch Viriol* 1999;**21**:1977-1990.

148. Bailly JE, McAuliffe JM, Durbin AP, Elkins WR, Collins PL, Murphy BR. A recombinant human parainfluenza virus type 3 (PIV3) in which the nucleocapsid N protein has been replaced by that of bovine PIV3 is attenuated in primates. *J Virol* 2000;**74**:3188-95.

149. Tao T, Davoodi F, Cho CJ, Skiadopoulos MH, Durbin AP, Collins PL, Murphy BR. A live attenuated recombinant chimeric parainfluenza virus (PIV) candidate vaccine containing the hemagglutinin-neuraminidase and fusion glycoproteins of PIV1 and the remaining proteins from PIV3 induces resistance to PIV1 even in animals immune to PIV3. *Vaccine* 2000;**18**:1359-66.

150. Hallak LK, Collins PL, Knudson W, Peeples ME. Iduronic acid-containing glycosaminoglycans on target cells are required for efficient RSV infection. *Virology* 2000;**271**:264-75.

151. Khattar SK, Yunus AS, Collins PL, Samal SK. Mutational analysis of the bovine respiratory syncytial virus nucleocapsid protein using a minigenome system: mutations that affect encapsidation, RNA synthesis, and interaction with the phosphoprotein. *Virology* 2000;**270**:215-228.

152. Tao T, Skiadopoulos MH, Davoodi F, Riggs JM, Collins PL, Murphy BR. Replacement of the ectodomains of the hemagglutinin-neuraminidase and fusion glycoproteins of recombinant parainfluenza virus type 3 (PIV3) with their counterparts from PIV2 yields attenuated vaccine candidates. *J Virol* 2000;**74**:6448-58.

153. Durbin AP, Skiadopoulos MH, McAuliffe JM, Riggs JM, Surman SR, Collins PL, Murphy BR. Human parainfluenza virus type 3 (PIV3) expressing the hemagglutinin protein of measles virus provides a novel method for immunization against measles virus and PIV3 in early infancy. *J Virol* 2000;**74**:6821-31.

154. Fearns R, Collins PL, Peeples ME. Functional analysis of the genomic and antigenomic promoters of human respiratory syncytial virus (RSV). *J Virol* 2000;**74**:6006-14.

155. Skiadopoulos MH, Surman, SR, Durbin AP, Collins PL, Murphy BR. Long nucleotide insertions between the HN and the L protein coding regions of human parainfluenza virus type 3 yield viruses with temperature sensitive and attenuation phenotypes. *Virology* 2000;**272**:225-34.

156. Bukreyev A, Whitehead SS, Prussin C, Murphy BR, Collins PL. Effect of co-expression of IL-2 by recombinant respiratory syncytial virus on virus replication, immunogenicity and production of other cytokines. *J Virol* 2000;**74**:7151-7157.

157. Teng MN, Whitehead SS, Bermingham A, St. Claire M, Elkins WR, Murphy BR, Collins PL. Recombinant RSV that does not express the NS1 or the M2-2 protein is highly attenuated and immunogenic in chimpanzees. *J Virol* 2000;**74**:9317-21.

158. Schmidt AC, McAuliffe JM, Huang A, Surman SR, Bailly JE, Elkins WR, Collins PL, Murphy BR, Skiadopoulos MH. Bovine parainfluenza virus type 3 (BPIV3) fusion and hemagglutinin-neuraminidase glycoproteins make an important contribution to the restricted replication of BPIV3 in non-human primates. *J Virol* 2000;**74**:8922-9.

159. Hallak LK, Spilmann D, Collins PL, Peeples ME. Glycosaminoglycan sulfation requirements for respiratory syncytial virus infection. *J Virol* 2000;**15**:10508-10513.

161. Bukreyev A, Murphy BR, Collins PL. Respiratory syncytial virus can tolerate an intergenic region of at least 160 nucleotides with little effect on transcription or replication in vitro and in vivo. *J Virol* 2000; **74**:11017- 11026.

162. Schmidt AC, McAuliffe JM, Murphy BR, Collins PL. Recombinant bovine/human parainfluenza virus type 3 (B/HPIV3) expressing the respiratory syncytial virus (RSV) G and G proteins can be used to achieve simultaneous mucosal immunization against RSV and HPIV3. *J Virol* 2001; **75**:4594-4603.

163. Lamb RA, Collins PL, Kolakofsky D, Melero JA, Nagai Y, Oldstone MBA, Pringle CR, Rima BK. *Paramyxoviridae.* pp 549-561 *In*, "Virus Taxonomy" Seventh Report of the International Committee on Taxonomy of Viruses. (Eds: M.H.V. van Reggenmortel, C.M. Fauquet, D.H.L. Bishop, E.B. Carstens, M.K. Estes, S.M. Lemon, J. Maniloff, M.A. Mayo, D.J. McGeoch, C.R. Pringle, and R.B. Wickner). Academic Press, San Diego.

164. Gower TL, Peeples ME, Collins PL, Graham BS, RhoA is activated during respiratory syncytial virus infection. *Virology* 2001; **283**:188-96.

165. Chanock RM, Murphy BR, Collins PL. Parainfluenza viruses. 2001. In Knipe D et al (eds.) *Virology,* Fourth Edition, Lippincott, Williams and Wilkins, pp 1341-1379.

166. Collins PL, Chanock RM, Murphy BR. 2001. Respiratory syncytial virus. In Knipe D et al (eds.) *Virology,* Fourth Edition, Lippincott, Williams and Wilkins, pp 1443-1485.

167. Tao T, Skiadopoulos MH, Davoodi F, Surman SR, Collins PL, Murphy BR. Construction of a live-attenuated bivalent vaccine virus against human parainfluenza virus (PIV) types 1 and 2 using recombinant PIV3 backbone. *Vaccine*. 2001; **19**:3620-3631.

168. Khattar SK, Yunus AS, Collins PL, Samal SK. Deletion and substitution analysis defined regions and residues within the phosphoprotein of bovine respiratory syncytial virus that affect transcription, RNA replication, and interaction with the nucleoprotein. *Virology* 2001; **285**:253-269.

169. Sutherland KA, Collins PL, Peeples ME. Synergistic effects of gene-end signal mutations and the M2-1 protein on transcription termination by respiratory syncytial virus. *Virology* 2001; **288**:295-307.

170. Yunus AS, Khattar SK, Collins PL, Samal SK Rescue of bovine respiratory syncytial virus from cloned cDNA: entire genome sequence of BRSV strain A51908. Virus Genes 2001 **23**:157-64.

171 Teng MN, Whitehead SS, Collins PL. Contribution of the respiratory syncytial virus (RSV) G glycoprotein and its secreted and membrane-bound forms to virus replication in vitro and in vivo. *Virology* 2001 **189**:283-296.

172. Skiadopoulos MH, Surman SR, Riggs JM, Collins PL, Murphy BR. A chimeric human-bovine parainfluenza virus type 3 expressing the measles virus hemagglutinin protein is attenuated for replication and is immunogenic in rhesus monkeys. *J Virol* 2001 **75**:10498-504.

173. Bukreyev A, Belyakov IM, Berzofsky JA, Murphy BR, Collins PL. Granulocyte-macrophage colony-stimulating factor expressed by recombinant respiratory syncytial virus attenuates viral replication and increases the level of pulmonary antigen presenting cells. *J Virol* 2001 **75**:12128-12140.

174. Newman JT, Surman SS, Riggs JM, Hansen C, Collins PL, Murphy BR, Skiadopoulos MH. Sequence analysis of the Washington/1964 strain of human parainfluenza virus type 1 (HPIV1) and recovery and characterization of wild type HPIV1 produced by reverse genetics. *Virus Genes* 2002 **24**:77-92.

175. Schmidt AC, Wenzke D, McAuliffe JM, St. Claire M, Elkins WR, Murphy BR, Collins PL. Mucosal immunization of rhesus monkeys against RSV subgroup A, subgroup B and HPIV3 using a live cDNA-derived vaccine based on a host range-attenuated bovine parainfluenza virus type 3 vector backbone. *J Virol* 2002 **76**:1089-99.

176. Fearns R, Peeples ME, Collins PL. Mapping the transcription and replication promoters of respiratory syncytial virus. *J Virol* 2002 **76**:1663-72

177. Techaarpornkul S, Collins PL, Peeples ME. Respiratory syncytial virus with the fusion protein as its only viral glycoprotein is less dependent on cellular glycosaminoglycans for attachment than complete virus. *Virology* 2002 **294**:296-304.

178. Skiadopoulos MH, Surman SJ, Riggs JM, Elkins WR, St.Claire M, Nishio M. Garcin D, Kolakosky D, Collins PL, Murphy BR. Sendai virus, a murine parainfluenza virus type 1 (PIV1), replicates to a similar level as human PIV1 in the upper and lower respiratory tract of African green monkeys and chimpanzees. *Virology* 2002; **297**:153-160.

179. Zhang L, Peeples ME, Boucher RC, Collins PL, Pickles RJ. Respiratory syncytial virus infection of human airway epithelial cells is polarized, specific to ciliated cells, and without obvious cytopathology. *J Virol* 2002; **76**:5654-5666.

180. Murphy BR and Collins PL. Principles underlying the use of reverse genetics to analyze and develop live attenuated vaccines for respiratory syncytial virus and parainfluenza viruses. *J Clin Invest* 2002; **110**:21-27.

181. Collins PL and Murphy BR. Respiratory syncytial virus: reverse genetics and vaccine strategies. *Virology* 2002; **296**:204-211.

182. Teng MN and Collins PL. The central conserved cystine noose of the attachment G protein of human respiratory syncytial virus is not required for efficient viral infection in vitro or in vivo. *J Virol* 2002; **76**:6164-6171.

183. Crowe JE, Collins PL, Murphy BR. Vaccines against respiratory syncytial virus (RSV) and parainfluenza virus types 1-3 (PIV1-3). In Levine MM et al (eds.)*New Generation Vaccines*. Marcel Dekker, New York

184. Polack FP, Teng MN, Collins PL, Prince GA, Exner M, Regele H, Lirman DD, Rabold R, Hoffman SJ, Karp CL, Kleeberger SR, Wills-Karp M, Karron RA. A role for immune complexes in enhanced respiratory syncytial virus disease. *J Exp Med* 2002; **196**:859-865.

185. Skiadopoulos MH, Surman SR, Riggs J, Orvell C, Collins PL, Murphy BR. Evaluation of the replication and immunogenicity of recombinant human parainfluenza virus type 3 vectors expressing up to three foreign glycoproteins. *Virology* 2002; **297**:136-152.

186. Kachko AV, Sorokin AV, Belanov EF, Ivanova AV, Bukreyev AA, Collins P, Netesov SV. Study of Translation and replication of the Marburg virus system constructed based on the viral genome. *Biochem Biophys Mol Biol (Russian)* 2002; **383**:409-413.

187. Krempl C, Murphy BR, Collins PL. Recombinant respiratory syncytial virus with the G and F genes shifted to the promoter-proximal positions. *J Virol* 2002; **76**:11931-11942.

188. Bukreyev A, Skiadopoulos MH, McAuliffe J, Murphy BR, Collins PL, Schmidt AC. More antibody with less antigen: can immunogenicity of live virus vaccines be improved? *Proc Nat Acad Sci USA* 2002; **99**:16987-16991.*

* *Selected for press release.*

189. Skiadopoulos MH, Vogel L, Riggs JM, Surman SR, Collins PL, Murphy BR. The genome length of human parainfluenza virus type 2 (HPIV2) follows the rule of six, and recombinant viruses recovered from non-polyhexameric antigenomes contain a biased distribution of correcting mutations *J Virol* 2003; **7**:270-279.

190, Young DF, Andrejeva L, Goodbourn S, Lamb RA, Collins PL, Elliot, RA and Randall RE. Virus replication in engineered human cells that do not respond to interferons *J Virol* 2003; **77**:2174-2181.

191. Skiadopoulos MH, Schmidt AC, Riggs JM, Surman SR, Elkins WR, StClaire M, Collins PL, Murphy BR. The determinants of the host-range restriction of attenuation of replication of bovine parainfluenza virus type 3 (BPIV3) in rhesus monkeys are polygenic. *Virology* 2003; **77**:1141-1148.

192. Kotelkin A, Prikhod'ko EA, Cohen JI, Collins PL, Bukreyev. Respiratory syncytial virus infection sensitizes cells to apoptosis mediated by tumor neucrosis factor-related apoptosis-inducing ligand (TRAIL). *J Virol* 2003; **77**:9156-9172.

193. Spann KM, Collins PL, Teng MN. Genetic recombination during co-infection of two mutants of human respiratory syncytial virus. *J Virol* 2003; **77**:11201-11211.

194. Biacchesi A, Skiadopoulos MH, Boivin G, Murphy BR, Collins PL, Buchholz UJ. Genetic diversity between two metapneumovirus subgroups. *Virology* 2003; **315**:1-9.

195. McAuliffe JM, Surman SR, Newman JT, Rigs JM, Collins PL, Murphy BR, and Skiadopoulos MH. Codon substitution mutations at two positions in the large polymerase protein of human parainfluenza virus type 1 yield viruses with a spectrum of attenuation *in vivo* and increased phenotypic stability *in vitro*. *J Virol* 2004; **78**:2029-2036.

196. Tran K-C, Collins PL, Teng MN. Effects of altering the transcription termination signals of respiratory syncytial virus (RSV) on viral gene expression and growth *in vitro* and *in vivo J Virol* 2004; **78**:692-699.

197. Newman JT, Riggs JM, Surman SR, McAuliffe J, Mulaikal TA, Collins PL, Murphy BR, Skiadopoulos MH. Generation of recombinant human parainfluenza virus yype 1 vaccine candidates by importation of temperature–sensitive and attenuating mutations from heterologous paramyxoviruses *J Virol* 2004; **78**:2017-2028.

198. Biacchesi S, Skiadopoulos HM, Tran K-C, Murphy BR, Collins PL, Buchholz UJ. Recovery of human metapneumovirus from cDNA: optimization of growth in vitro and expression of additional genes *Virology* 2004; **321**:247-259.

199. Johnson, TR, Teng, MN, Collins PL, Graham BS. Respiratory syncytial virus (RSV) G glycoprotein is not necessary for vaccine-enhanced disease induced by immunization with formalin-inactivated RSV. *J Virol* 2004; **78**:6024-32.

200. Spann, KM, Tran, KC, Chi, B, Rabin, RL, Collins, PL. Suppression of the induction of IFN alpha, beta and lambda by the NS1 and NS2 proteins of human respiratory syncytial virus in human epithelial cells and macrophages. *J Virol* 2004; **78**:4363-4369.

201. Skiadopoulos, MH, Stéphane, B, Buchholz, UJ, Riggs JM, Surman, SR, Amaro-Carambot, E, McAuliffe, JM, Elkins, WR, St.Claire, Collins, PL, and Murphy BR. The two major human metapneumovirus (HMPV) genetic lineages are highly related antigenically in rodents and nonhuman primates and the fusion (F) glycoprotein is a major contributor to this antigenic relatedness. *J Virol* 2004; **78**:6927-6937.

202. Bisht H, Roberts A, Vogel L, Bukreyev A, Collins PL, Murphy B, Subbarao K, Moss B. SARS coronavirus spike protein expressed by attenuated vaccinia virus induces neutralizing antibody and protectively immunizes mice. *Proc Natl Acad Sci USA*, 2004; **101**:6641-6646*

* *Selected for press release*

203. Bukreyev A, Lamirande EW, Buchholz UJ, Vogel LN, Elkins WR, St. Claire M, Murphy BR, Subbarao K, Collins PL. Mucosal immunization of African green monkeys (*Cercopithecus aethiops)* with an attenuated parainfluenza virus expressing the SARS coronavirus spike protein for the prevention of SARS. *Lancet* 2004, **363**:2122-2127*.

* *Selected for press release*

204. Buchholz UJ, Bukreyev A, Yang L, Lamirande EW, Murphy BR, Subbarao, K, Collins PL. Contributions of the structural proteins of Severe Acute Respiratory Syndrome coronavirus to protective immunity. *Proc Natl Acad Sci USA* 2004; **101**:9804-9809*.

* *Selected for press release*

205. Biacchesi S, Skiadopoulos MH, Yang L, Lamirande E, Tran KC, Murphy BR, Collins PL, and Buchholz UJ. Recombinant human metapneumovirus lacking the small hydrophobic SH and/or attachment G glycoprotein: deletion of G yields a promising vaccine candidate, *J Virol* 2004; **78**:12877-87.

206. Krempl CD, and Collins PL. Re-evaluation of the virulence of the prototypic strain 15 of pneumonia virus of mice (PVM). *J Virol* 2004; **78**:13362-5.

207. Schomacker H, Collins PL, Schmidt AC. *In silico* identification of a putative new paramyxovirus related to the Henipavirus genus. *Virology* 2004; **330**:178-85.

208. Zhang L., Bukreyev A, Thompson C, Peeples ME, Watson B, Collins PL, Pickles RJ. Infection of ciliated cells by human parainfluenza virus type 3 in an *in vitro* model of human airway epithelium. *J Virol* 2005; **79**:1113-24.

209. Krempl CD, Lamirande EW, Collins PL. Complete sequence of the RNA genome of pneumonia virus of mice (PVM) *Virus Genes* 2005; 30:237-248.

210. McGiven DR, Collins PL, Fearns R. Identification of internal sequences in the 3′ leader region of human respiratory syncytial virus that enhance transcription and confer replication processivity. *J Virol* 2005 79:2449-2460.

211. Karron RA, Wright PW, Belshe RB, Thumar B, Casey R, Newman F, Polack FP, Randolph VB, Deatly A, Hackell J, Gruber W, Murphy BR, Collins PL. Identification of a recombinant live-attenuated respiratory syncytial virus vaccine candidate that is highly attenuated in infants. *J Infect Dis* 2005; 191:1093-1104.

212. Spann KM, Tran KC, Collins PL. Effects of nonstructural proteins NS1 and NS2 of human respiratory syncytial virus on regulatory factor 3, NF-kappaB and expression of pro-inflammatory chemokines. *J Virol* 2005; 79:5353-5362.

213. Gower TL, Pastey MK, Peeples ME, Collins PL, McCurdy LH, Hart TK, Gurth A, Johnson TR, Graham BS. RhoA signaling is required for respiratory syncytial virus-induced syncytium formation and filamentous virus morphology. *J Virol* 2005; 79:5326-5336.

214. Bartlett EJ, Amaro-Carambot E, Surman SR, Newman JT, Collins PL, Murphy BR, Skiadopoulos MH. Human parainfluenza virus type 1 (HPIV1) vaccine candidates designed by reverse genetics are attenuated and efficacious in African green monkeys. *Vaccine* 2005; 23:4631-4646.

215. Buchholz UJ, Biacchesi S, Pham QN, Tran KC, Yang L, Luongo CL, Skiadopoulos MH, Murphy BR, Collins PL. Deletion of M2 gene open reading frames 1 and 2 of human metapneumovirus: Effects on RNA synthesis, attenuation and immunogenicity. *J Virol* 2005; 79:6588-6597.

216. Bukreyev A, Belyakov IM, Prince GA, Yim KC, Harris KK, Berzofsky JA, Collins PL. Expression of interleukin-4 by recombinant respiratory syncytial virus is associated with accelerated inflammation and a non-functional cytotoxic T lymphocyte response following primary infection but not following challenge with wild-type virus. *J Virol* 2005; 79:9515-9526*

**selected for J Virol spotlight and Faculty of 1000*

217. Lamb, R.A., P.L. Collins, D. Kolakofsky, J.A. Melero, Y. Nagai, M.B.A. Oldstone, C.R. Pringle and B.K. Rima. 2005. *Paramyxoviridae In,* "Virus Taxonomy," Eighth Report of the International Committee on Taxonomy of Viruses, (eds. C. M. Fauquet, M.A. Mayo, J. Maniloff, U. Desselberger, and L.A. Ball), pp. 655-668. Elsevier/Academic Press, London.

218. Collins PL and Murphy BR. New generation live vaccines against human respiratory syncytial virus designed by reverse genetics. *Proceedings of the American Thoracic Society* 2005; 2:166-173.

219. Ghildyal R, Li D, Peroulis I, Shields B, Bardin PG, Teng MN, Collins PL, Meanger J, Mills J. Matrix protein of respiratory syncytial virus interacts with the G glycoprotein cytoplasmic domain in the cytoplasm. *J Gen Virol* 2005; 86:1879-84

220. Biacchesi S, Skiadopoulos MH, Yang Y, Murphy BR, Collins PL, and Buchholz UJ. Rapid human metapneumovirus microneutralization assay based on green fluorescent protein expression. *J Virol Methods* 2005; 128:192-197.

221. Nolan SM, Surman SR, Amaro-Carambot E, Colllins PL, Murphy BR, Skiadopoulos HM. Live-attenuated intranasal parainfluenza virus type 2 vaccine candidates developed by reverse genetics containing L polymerase mutations imported from heterologous paramyxoviruses. *Vaccine* 2005; 23:4765-4774.

222. Polack FP, Irusta PM, Hoffman SJ, Schiatti MP, Melendi GA, Delgado MF, Laham FR, Thumar B, Hendry RM, Karron RA, Collins PL, Kleeberger SR. The cysteine-rich region of the respiratory syncytial virus attachment protein inhibits the innate immune response elicited by the virus and endotoxin. *Proc Natl Acad Sci USA* 2005; 102:8996-9001.

223. Biacchesi S, Pham QN, Skiadopoulos MH, Murphy BR, Collins PL, Buchholz UJ. Infection of non-human primates with recombinant human metapneumovirus lacking the SH, G or M2-2 protein catagorizes each as a nonessential accessory protein and identified promising vaccine candidates. *J Virol* 2005; 79:12608-12613.*

**selected for J Virol spotlight*

224. Bukreyev A., Huang Z, Yang L, Subbiah E, St. Claire M, Murphy BR, Samal SK, Collins PL. Recombinant Newcastle disease virus expressing a foreign viral antigen is attenuated and highly immunogenic in primates. *J Virol* 2005; 799:13275-84.

225. Tarran R, Button B, Picher M, Paradiso AM, Ribeiro CM, Lazarowski ER, Zhang L, Collins PL, Pickles RJ, Fredburg JJ, Boucher RC. Normal and cystic fibrosis airway surface liquid homeostatis: the effects of phasic shear stress and viral infections. *J Biol Chem* 2005; 280:35751-9.

226. Wright PF, Karron RA, Madi SA, Treanor JJ, King JC, O'Shea A, Ikizler MR, Zhu Y, Collins PL, Randolph VB, Deatly A, Gruber WC, Murphy BR. The interferon antagonist NS2 protein of respiratory syncytial virus is an important virulence determinant in humans. *J Infect Dis* 2006; 193: 573-81

227. Bartlett EJ, Amaro-Carambot E, Surman SJ, Collins PL, Murphy BR, and Skiadopoulos MH. Introducing mutations into the P/C gene of human parainfluenza virus type 1 (HPIV1) by reverse genetics generates attenuated and efficacious vaccine candidates. *Vaccine* 2005; 24:2674-84.

228. Pham QN, Biacchesi A, Skiadopoulos MH, Murphy BR, Collins PL, and Buchholz UJ. Chimeric recombinant human metapneumoviruses with the nucleocapsid or phosphoprotein open reading frame replaced by that of avian metapneumovirus exhibit improved growth in vitro and attenuation in vivo. *J Virol* 2005; 79:15114-22.

229. Sims AC, Baric RS, Yount B, Burkett SE, Collins PL, and Pickles RJ. SARS-CoV infection of human ciliated airway epitheliumL The role of ciliated cells in viral spread in the conducting airways of the lung. *J Virol* 2005; 79:15511-24.

230. Skiadopoulos, MH, Biacchesi S, Buchholz UJ, Amaro-Carambot E, Surman SR, Collins PL, and Murphy BR. Individual contributions of the human metapneumovirus (HMPV) F, G, and SH surface glycoproteins to the induction of neutralizing antibodies and protective immunity *Virology* 2006; 345:492-501

231. Bukreyev A, Yang L, Zaki SR, Shieh W-J, Rollin PE, Murphy BR, Collins PL, and Sanchez A. A single intranasal inoculation with a paramyxovirus-vectored vaccine protects guinea pigs against a high-dose Ebola virus challenge. *J Virol* 2006; 80:2267-79.

232. Chi B, Dickensheets HL, Spann KM, Alston MA, Luongo C, Renaud J-C, Kotenko SV, Graham BS, Roederer M, Beeler JA, Donnelly RP, Collins PL, Rabin RL. IFN-α IFN-λ together mediate suppression of CD4 T cell proliferation induced by human respiratory syncytial virus. *J Virol* 2006; 80:5032-40.

233. Bukreyev A, Serra ME, Laham FR, Kleeberger SR, Collins PL, Polack FP. The cystine noose of the attachment glycoprotein of respiratory syncytial virus is critical for cytotoxic T lymphocyte responses despite lacking MHC class I-restricted epitopes. *J Virol* 2006; 80:5854-5861.*

**selected for J Virol spotlight*

234. Biacchesi S, Pham QN, Skiadopoulos MH, Murphy BR, Collins PL, Buchholz UJ. Modification of the monobasic cleavage activation site of the F0 protein of human metapneumovirus to conform to that of the furin protease does not increase replication and spread in rodents and non-human primates. *J Virol* 2006; 80:5798-5806.

235. Kotelkin A, Belyakov IM, Yang L, Berzofsky JA, Collins PL, Bukreyev. The NS2 protein of human respiratory syncytial virus suppresses the cytotoxic T cell response as a consequence of suppressing the type I interferon response. *J Virol* 2006; 80:5958-5967.

236. Van Cleve W, Amaro-Carambot E, Surman SR, Collins PL, Zoon KC, Murphy BR, Skiadopoulos MH, Bartlett EJ. Attenuating mutations in the P/C gene present in human parainfluenza virus type 1 (HPIV1) vaccine candidates affect both induction of and signaling by type I interferon (IFN) by wild type HPIV1 *Virology* 2006; 352:61-73

237. Collins PL and Murphy BR. 2006. Vaccines against human respiratory syncytial virus, 2006, pp 233-278, *In* Cane P (ed) *Respiratory Syncytial Virus*, *Perspectives in Medical Virology, vol 13*, Zuckerman A and Mushahwar I (eds), Elsevier Press/

238. Karron RA and Collins PL. 2006. Parainfluenza viruses. 2006, pp 1497-1526, *In* Knipe D and Howley P (eds.) *Virology,* Fifth Edition, Lippincott, Williams and Wilkins.

239. Collins PL, and Crowe JE Jr. 2006. Respiratory syncytial virus and metapneumovirus. 2001, pp 1601-1646, *In* Knipe D and Howley P (eds.) *Virology,* Fifth Edition, Lippincott, Williams and Wilkins.

240. Bukreyev A, Skiadopoulos MH, Murphy BR, Collins PL. Non-segmented negative stand viruses as vaccine vectors. *J Virol* 2006; 80:10293-306.*

* *Minireview*

241. Buchholz UJ, Nagashima K, Murphy BR, Collins PL. Live vaccines against human metapneumovirus designed by reverse genetics. *Expert Rev Vaccines* 2006; 5:695-706.

242. Collins PL. Respiratory syncytial virus. 2006. In Encyclopedia of Virology, in press

243. Surman SR, Collins PL, Murphy BR, Skiadopoulos MH. An improved method for recovery of recombinant paramyxovirus vaccine candidates suitable for use in clinical trials. *J Virol Meth* 2007; 141:30-33.

244. Biacchesi S, Murphy BR, Collins PL, Buchholz UJ. Frequent frame shift and point mutations in the SH gene of human metapneumovirus. *J Virol*, 2007; 81:6057-6067.

245. Bukreyev A, Rollin PE, Tate MK, Yang L, Zaki SR, Shieh W-J, Murphy BR, Collins PL, Sanchez. Successful topical respiratory tract immunization of primates against Ebola virus. *J Virol*, 2007; 81:6379-6388.

246. Di Napoli JM, Kotelkin A, Yang L, Elankumaran A, Murphy BR, Samal SK, Collins PL, Bukreyev A. Newcastle disease virus, a highly host-range-restricted virus, as a vaccine vector against emerging pathogens *Proc Natl Acad Sci USA* 2007; 104:9788-9793. *

* *Selected for press release*

247. Bartlett EJ, Castano A, Surman SR, Collins PL, Skiadopoulos MH, Murphy BR. Attenuation and efficacy of human parainfluenza virus type I (HPIV1) vaccine candidates containing stabilized mutations in the P/C and L genes. *Virol J* 2007; 4:67

248. Nolan SM, Skiadopoulos MH, Bradley K, Kim OS, Bier S, Amaro-Carambot E, Surman SR, Davis S, St Claire M, Elkins R, Collins PL, Murphy BR, Schaap-Nut A. Recombinant human parainfluenza virus type 2 vaccine candidates containing a 3′genomic promotert and L polymerase mutations are attenuated, protective, and genetically stable in non-human primates. *Vaccine* 2007; 25:6409-6422.

249. Krempl CD, Wnekowicz A, Lamirande EW, Nayebagha G, Collins PL, Buchholz UJ. Identification of a novel virulence factor in recombinant pneumonia virus of mice. *J Virol* 2007; 81:9490-501.

250. Budworth J, Abbott E, Alber DG, Carron EA, Carter MC, Chambers P, Chubb A, Cockerill S, Collins PL, Dowdell VCL, Kelsey RD, Lockyer MJ, Luongo C, Najarro P, Pickles RJ, Taylor D, Tyms S, Wilson LJ, Powell KL. R604: A novel inhibitor of respiratory syncytial virus replication. *Antimicrob Agents Chemother* 2007; in press

251. Melendi GA, Zavala F, Buchholz UJ, Boivin G, Collins PL, Kleeberger S, Polack FP. Mapping and characterization of the primary and anamnestic H-2d restricted cytotoxic T lymphocyte response in mice against human metapneumovirus. *J Virol* 2007;

252. DiNapoli JM, Yang L, Suguitan A, Elankumaran S, Doward DW, Murphy BR, Samal SK, Collins PL, Bukreyev. Immunization of primates with a Newcastle disease virus-vectored vaccine via the respiratory tract induces a high titer of serum neutralizing antibodies against highly pathogenic avian influenza virus. *J Virol* 2007

253. Wright PF, Karron RA, Belshe RB, Shi JR, Randolph VB, Collins PL, O'Shea AF, Gruber WC, Murphy BR. The absence of enhanced disease with wild-type respiratory syncytial virus infection occurring after receipt of live, attenuated, respiratory syncytial virus vaccines. *Vaccine* 2007

254. Harker J, Bukreyev A, Collins PL, Wang B, Openshaw PJM, Tregoning JS. Virally delivered cytokines alter the immune response to future lung infections. J Virol.

255. Collins PL and Graham BS. Viral and host factors in human respiratory syncytial virus pathogenesis. *J Virol* *

* *Invited Mini-review*

256. Bukreyev A and Collins PL. Advances in the development of vaccines against Marburg and Ebola viruses *Future Virology*

257. Vallbracht S, Jessen B, Mrusek S, Enders A, Collins PL, Ehl S, Krempl CD. A single viral epitope determines T cell response and disease after infection of mice with respiratory syncytial virus. *J Immunol*